THURSDAY, FEBRUARY 6, 1896.

RECENT PSYCHOLOGICAL LITERATURE.

Outlines of Psychology. By Oswald Külpe. Translated by E. B. Titchener. Pp. xi + 462. (London: Swan Sonnenschein and Co. New York: Macmillan and Co., 1895.)

Studies in the Evolutionary Psychology of Feeling. By Hiram M. Stanley. Pp. viii + 392. (London: Swan Sonnenschein and Co. New York: Macmillan and Co., 1895.)

Mental Physiology. By Theo. B. Hyslop. Pp. xv + 552. (London: J. and A. Churchill, 1895.)

Moral Pathology. By Arthur E. Giles. Pp. viii + 179. (London: Swan Sonnenschein and Co. New York: Charles Scribner's Sons, 1895.)

PROF. TITCHENER has followed up his translation of Wundt's "Vorlesungen über die Menschen- und Thierseele" by performing the same office for Külpe's "Grundriss der Psychologie." This book is one of the most important of recent additions to psychological literature, and it is very fortunate that the task of translation should have fallen into such able hands. The result is an extremely accurate and readable version, supplemented by a new section on the experimental investigation of memory and association, written on the author's suggestion, an index of names, and several minor additions. Prof. Külpe has an acknowledged position as an experimental psychologist, and belongs to the school of Wundt, but his general attitude differs to some extent from that of his master, and more nearly approaches pure presentationism or associationism. The synthetic view of mind as built up of simple elements is rigorously followed, perhaps too rigorously, when the processes which are concerned in reaction time experiments are brought under the heading of connections of elements. The book has two chief divisions; the first deals with the elements of consciousness, which are divided into sensations and feelings, the former being subdivided into those peripherally excited, or, as more commonly called, presentational elements, and those centrally excited, or representational elements. The problems of association and memory are discussed under the latter heading. In the second division two modes of connection of these elements are considered. The first is termed fusion, of which the most striking instances occur in the cases of hearing and of the emotions. The latter are regarded as fusions of sensations and feelings. The second mode of connection was termed by Külpe "Verknüpfung," and this has been translated "colligation." This division is chiefly devoted to spatial and temporal relations. These are regarded as depending on "colligation" of the conscious elements. As regards spatial perception, however, the author inclines towards a nativistic position; and if this were definitely adopted, this subject would come under the elementary conditions of consciousness, and would have to be treated in its more usual place in connection with sensation. This is the least satisfactory part of the book. A comparatively short final division deals with the nature of attention, which is held to be a special state of consciousness in which the elements already described are presented, and is not regarded as a condition or process apart from the conscious content. The author's attitude here seems to be separated by very little from that of the presentationist school. As already stated in NATURE, when noticing the German edition, the book is likely to be largely used as a text-book.

Mr. Hiram Stanley, in his book on the evolutionary psychology of feeling, endeavours to establish the view, of which Horwicz has hitherto been the most prominent advocate, that feeling is the primitive mental state. Mr. Stanley supposes that consciousness first appeared as pain; that the state of the first conscious organism was one of unconsciousness with transient flashes of pain, and that similarly the psychical life of very young infants consists of intermittent pains interrupted by long intervals of sleep. The cognitive side of mind is held to be a later development. Fear is regarded as the primitive emotion which arises with cognition of object and with power of representation. Progress in sensibility is regarded as dependent on effort stimulated by pain; higher mental developments being only attained as the result of severe struggle. The evolution of mind is regarded as dependent on the stimulating influence of pain on volition. Unfortunately these highly interesting conclusions are not reached in a very scientific manner. The contradiction to the principles of evolution involved in the supposition that any of the specialised mental states experienced by us can be primitive, does not appear to have occurred to the author. The conclusions do not appear to be adequately based either on observation or experiment; the view, already mentioned, that the conscious state of the infant is mainly one of pain, appears to be derived from Preyer. The reader is often left in doubt as to whether statements made by the author are facts or opinions; thus, in considering the priority of touch and pain, it is stated that "a man in a 'brown study' inadvertently touching a hot stove has pain, then warmth, then touch sensation"; we are not told whether this order has been actually observed by any one; it is certainly opposed to common experience. Although the author's method is not scientific, and his conclusions questionable, the book has many points of interest. In considering the emotions, there is much skilful psychological analysis; the knowledge of previous thought on the subject is considerable, and there is much that is stimulating and suggestive. The chapter on desire may be mentioned as especially interesting.

Dr. Hyslop's book deals with the relations of the nervous system and the mind, especially in their bearings on mental disease, and a large part of the book is devoted to pathological questions. The book seems to be directed against the materialistic views which prevail among those who have to do with mental disease, at any rate in this country. Current hypotheses about the physiological basis of the higher mental processes are discussed and vigorously criticised, but less attention is paid to the positive knowledge which we possess, especially in relation to sensation and perception. The experimental aspect of psychology is almost wholly neglected, even when it is of a physiological nature, as in much recent

work on the bodily accompaniments of feeling and emotion.

The idea of "moral pathology" is very much in evidence at present, underlying as it does the work of Lombroso and his school. Dr. Giles' book is of a very different kind. It is an unpretentious sketch of moral defects from the point of view of the physician, considered under such headings as causation, diagnosis, prognosis and treatment. The work cannot be regarded as an important contribution to ethical science, but it is written brightly and with common sense. The principles which regulate diagnosis and treatment in medical practice are applied with considerable ingenuity to moral disease. There is an interesting chapter in which the idea of morbid diathesis is applied, and several types of character which predispose to moral disease are sketched.

PROTOTYPES OF THE FUNGI.

Protobasidiomyceten. Untersuchungen aus Brasilien. Von Alfred Möller. Pp. xiv + 179. (Jena: Fischer, 1895.)

THE present work forms the eighth part of Dr. Schimper's "Botanischen Mittheilungen aus den Tropen." The author is well known for his mycological researches, having previously contributed two parts to the above-named communications—"The Fungus-Gardens of some South American Ants," and "Brazilian Fungus-Flowers." To Elias Fries is due the credit of having first reduced the previous chaotic condition of mycology to an intelligent and scientific standpoint; even much beyond what could have been expected, considering that naked eye characters, or at most when aided by a pocket lens, were only available. Berkeley and Tulasne followed, and, aided by the microscope, added greatly to our knowledge of the minute structure and affinities of the various groups of fungi, a knowledge which has been in some instances more readily utilised than acknowledged by their successors. Later, De Bary's classical work indicated clearly what could be done, by means of pure cultures, towards the elucidation of the life-history of species, and a knowledge of true affinities; a method which is being developed at the present day by Brefeld, to the extent that the last-named author has presented us with his idea of the gradual evolution of the fungi, from their algal ancestors to the highly differentiated, asexual condition, represented by the members of the Basidiomycetes. As usual in classifications based on progressive morphological development, connecting links between groups that the evidence at hand suggest as forming a natural sequence, are not always forthcoming. The purport of the work under consideration is to make known a series of such connecting links or primitive types of the great group of fungi known as the Basidiomycetes; and if the author's conclusions prove to be well founded, the neighbourhood of Blumenau, in the province of Santa Catharinea, Brazil, where the material was collected, must be looked upon as a veritable garden of prototypes of the higher fungi.

Brefeld's conception of the Basidiomycetes, characterised by a single feature, the basidium or spore-bearing organ, which must be a terminal, clavate, or sub-cylindrical cell, bearing at its apex four—less frequently two—slender prolongations, or sterigmata, each of which bears a spore at its tip, is accepted, and the evolution of this group from the Ustilagineæ is bridged over by six families, collectively constituting the transition group called Protobasidiomycetes. Four of the transition families agree in having the basidium furnished with transverse septa, hence formed of two or more superposed cells, and bearing the spores laterally. In the remaining two families the basidia are vertically divided into four lobes, each of which runs out into a sterigma bearing a spore at its apex. The sub-families and genera of these families are considered as furnishing transitions to the Basidiomycetes proper. The following illustrate the value of these transition stages, being new sub-families and genera included in the Tremellaceæ, one of the families described above as having vertically divided basidia:—

Protopolyporeæ: Tremellaceæ with the aspect of the hymenium like that of the Polyporeæ.

Protohydneæ: Tremellaceæ with the hymenium resembling that of the Hydneæ.

Genera are as follows:—

Protomerulius: Macroscopic appearance that of the genus Merulius, but with basidia of the Tremellæ.

It is doubtful as to whether the author's view of transition groups, as illustrated above, will be accepted by mycologists. The genus *Merulius* is a typical Basidiomycete, so far as its basidia are concerned, but that something looking superficially like *Merulius*, but having basidia of a lower type, is the prototype of *Merulius*, appears to be more a matter of faith than of conviction. The same argument is applied everywhere; the general appearance is that of some well-known family or genus of the Basidiomycetes, but the structure of the basidia is that of the Protobasidiomycetes.

A wider knowledge of living species, or even a careful study of the material in any large herbarium, will in all probability convince the author that the lower forms of the Basidiomycetes are very plastic, nearly all the simpler genera being superficially mimicked by the unstable species of *Tremella* and its allies. On the other hand, it is not unusual to find specimens belonging to the simpler genera of the true Basidiomycetes presenting a superficial resemblance to species of *Tremella*, &c. As examples may be mentioned *Corticium arachnoideum*, Berk., which is sometimes a typical *Corticium* with a dense, waxy hymenium; at others the substance is very loose, dry, and the basidia scattered, when it mimicks *Hypochnus;* or again, *Coniophora puteana*, Cke., *Forma cerebella*, Sacc., on account of the Merulius-like hymenium. The author has considered structures worthy of subfamily and generic rank, what others would not consider as entitled to rank as a variety of a species.

Nevertheless, if all the author's deductions cannot be accepted, we are at the same time greatly indebted for the large amount of additional knowledge, the result of careful and conscientious investigations, carried out under most favourable conditions, pertaining to those primitive forms of the Basidiomycetes, which hitherto had received but scant attention.

GEO. MASSEE.

OUR BOOK SHELF.

Étude chimique du Glycogène chez les Champignons et les levûres. Par Dr. G. Clautriau, Assistant a l'institut botanique, Université de Bruxelles. (Hayez, 1895.)

THE absence of starch from the tissues of the fungi has been generally considered as correlated with their inability to form carbohydrate food material from the CO_2 of the atmosphere, and for a long time it was considered that such carbonaceous reserve materials as they possessed existed only, or at any rate chiefly, in the form of fatty or oily bodies. Within comparatively recent years it has been shown by Errera and other observers that this does not represent the whole of the facts, and that though starch is absent, a very nearly allied body, glycogen, replaces it. The work under notice is a record of some very careful researches, carried out at the Botanical Institute at Brussels, to ascertain the true nature of this glycogen, and whether it is identical or no with the glycogen found in the liver and muscles of many animals.

The chief obstacle in the investigation is due to the peculiar nature of the vegetable organism. Apart from the question of extracting a material like glycogen from a tissue in which cell membranes form a very prominent feature, there remains the difficulty that very many of the decomposition products of cellulose are dissolved by the same solvent, and form mucilaginous material which it is extremely difficult to separate later from the extract of the fungi. The author of the book has with very great pains elaborated a method which enables him to prepare the glycogen in a pure state, and without a very great loss of material. The details of his process are too long to narrate in full; they may be briefly indicated by saying that the fungus is dried at a sufficiently high temperature to destroy the enzyme which is present with the carbohydrate, and reduced to powder by various means. The powder is repeatedly extracted with dilute caustic potash solution till no more glycogen is dissolved. The mucilaginous matter is got rid of by causing an inert inorganic precipitate to be formed in the solution which carries down the mucilage, but leaves the glycogen in solution. The latter is then purified, by treatment which is very fully detailed.

The glycogen has been thus prepared from many species of fungi, including Boletus, Amanita, Phallus and others, also from several yeasts.

Prepared thus, and examined side by side with the animal product obtained from the liver of the rabbit, the two appear to be identical. The solutions are faintly opalescent, and deflect the plane of polarisation to the same extent in the two cases. Both yield maltose when acted on by saliva, and dextrose when boiled for some time with weak mineral acids. Their percentage composition is the same, corresponding, according to the author, to the formula $6(C_6H_{10}O_5)+H_2O$.

The latter portion of the work is devoted to an examination of the chemical and physical properties of glycogen, particularly its relation to iodine, with which it gives a characteristic brown colouration.

Dr. Clautriau is to be congratulated on making a valuable contribution to our knowledge of the carbohydrate metabolism of the group of plants with which he has been engaged.

Popular Telescopic Astronomy. By A. Fowler, A.R.C.S., F.R.A.S. Pp. vi + 77. (London: George Philip and Son, 1896.)

ASTRONOMY has no direct bearing upon industry, therefore it is neglected in this utilitarian age. Technical education is made to include such subjects as political economy, problems of poverty, and great painters; but the authorities which decide what is or is not technical knowledge, draw a line at celestial science. The result is that astronomy is more studied for its own sake than any other science. But by merely reading popular astronomical literature, it is not possible to obtain a truly scientific knowledge of the heavenly bodies; personal observation of the varying aspects of the midnight sky, and of the chief characteristics of celestial objects is essential practical work compared with which book learning is as nothing. Two obstacles have hitherto prevented a wide enjoyment of the beauties of celestial scenery—first, the prohibitive prices which opticians charge for even small telescopes; and secondly, the absence of small and trustworthy guides to the heavens, suitable for those who have no idea what to seek and where to look. There are several most valuable works for the initiated amateur, but few are of a kind that the unexperienced observer finds intelligible. Mr. Fowler's little book removes both the obstacles referred to. In the words of the sub-title, it is a book showing "how to make a 2-inch telescope, and what to see with it," and very admirably is the promise of the title-page fulfilled. The telescope described is made by each student in the course of Astronomical Physics at the Royal College of Science, South Kensington. By following out the instructions given, a serviceable instrument can be constructed, capable of bringing into view a multitude of stars and sights beyond the range of the unaided vision. There can be no doubt that whoever makes his own telescope, not only performs thereby a valuable exercise in optics, but he is not likely to make such foolish mistakes as the astronomical tyro who procures his polished instrument from the opticians, and looks upon it as akin to a box of tricks.

Two chapters of the book are taken up with the details of the construction of the telescope, and hints on the practical use of it. Then come descriptions of star seasons, accompanied by four maps showing the chief constellations; and the remaining seven chapters are devoted to observations of the sun, moon, planets, comets, stars, double stars, star-clusters, and nebulæ. The whole of the work explained can be easily understood and readily performed. The book is practicable as well as practical; every instruction in it can be carried out, every observation described bears the impress of experience. Astronomy will gain more by the publication of this little volume than by the issue of a score of works of a descriptive character.

Anleitung zur Molekulargewichtsbestimmung. Von Dr. Gotthold Fuchs. (Leipzig: Wilhelm Engelmann, 1895.)

THIS little book of 41 pages is specially written as a laboratory guide to the methods of determining molecular weights from observations of the freezing-point and boiling-point of solutions made by means of the Beckmann pieces of apparatus. It contains short historical accounts of the theory of the two methods, and descriptions of the apparatus, including the latest modifications, and the modes of making the observations. Lists of data for calculating results when using different solvents, and numerous examples of the kind of values obtained, taken from Beckmann's papers, are also included. The author is careful to direct attention to the anomalies likely to be met with, and has succeeded in writing a trustworthy account of the present condition of these two widely used methods. J. W. R.

Recettes de l'Électricien. By É. Hospitalier. Pp. vi + 352. (Paris: G. Masson, 1895.)

AN electrician's pocket-book, full of workshop receipts, and containing numerous hints of use in electrical laboratories. In the selection of the receipts, the author has exercised discretion, and in their arrangement he shows that he understands exactly the requirements of electrical artificers and engineers.

LETTERS TO THE EDITOR.

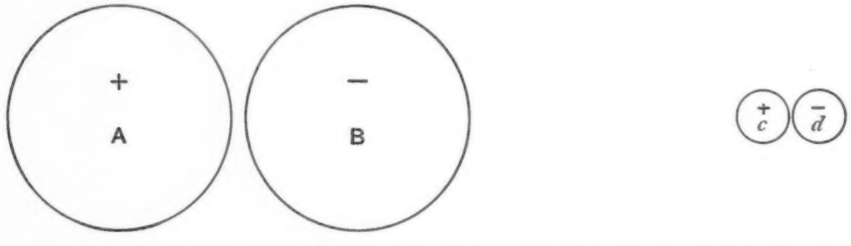
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Velocity of Propagation of Electrostatic Force.

DR. BOTTOMLEY'S note published in NATURE of January 23, quotes an extract from my Baltimore Lectures of October 1884, in which this subject is spoken of, with an illustration consisting of two metal spheres at a great distance asunder, having periodically varying opposite electrifications maintained in them by a wire connecting them through an alternate current dynamo.

For an illustration absolutely freed from connecting wire and all complications, consider four metal spheres, A, B, *c*, *d*, with their centres all in one straight line;—their relative magnitudes and positions being such as shown in the accompanying diagram. Let each of the four be initially electrified, A and *c*, positively, B and *d*, negatively. Let the charges on *c* and *d* be so strong that a spark is only just prevented from passing between them by the influence of B and A. Let A be gradually brought nearer to B till a spark passes between them. Will the consequent spark between *c* and *d* take place at the same instant or a little later? It is not easy to see how this question could be answered experimentally; but remembering the wonderful ingenuity shown by Hertz in finding how to answer questions related to it, we need not perhaps despair to see *it* also answered by experiment.

The elastic solid theory restricted to the supposition of incompressibility (which is expressed by Maxwell's formulas) makes the difference of times between the two sparks infinitely small.



The unrestricted elastic solid theory gives for the difference of times the amount calculated according to the velocity of the condensational-rarefactional wave.

But I feel that it is an abuse of words to speak of the "elastic solid theory of electricity and magnetism" when no one hitherto has shown how to find in an elastic solid anything analogous to the attraction between rubbed sealing-wax and a little fragment of paper; or between a loadstone or steel magnet and a piece of iron; or between two wires conveying electric currents. Elastic solid, however, we must have, or a definite mechanical analogue of it, for the undulatory theory of light and of magnetic waves and of electric waves. And consideration of the definite knowledge we have of the properties of a real elastic solid, which we have learned from observation and experiment, aided by mathematics, is exceedingly valuable in suggesting and guiding ideas towards a general theory which shall include light (Old and New), old and new knowledge of electricity, and the whole of electro-magnetism.

KELVIN.

The New Actinic Rays.

MAY I point out that an unnecessary amount of energy is being expended on Röntgen's photographs—I mean electrical energy.

I have succeeded in obtaining perfectly sharp and fully-exposed negatives from an action of four minutes' duration, even when a thin aluminium plate is placed in front of the sensitive film, and the rays are excited in a Crookes' bulb connected direct (*i.e.* with no Leydens inserted) with the secondary terminals of an Apps' induction coil, which gives (in its present condition) a three-inch spark in air when worked, as in the present experiments, by three small accumulator cells. This is much smaller, however, than that used in the published experiments of others who have been doing similar work.

University College, London. ALFRED W. PORTER.

THE accompanying photograph may perhaps interest those who are engaged in the photography of invisible objects. It was taken in the following way. Upon a piece of board I placed a sensitive plate, on this a penny-piece with the obverse side downwards, and on the top of the penny-piece a $\frac{3}{16}$-inch cedar board. The whole was exposed to the light emitted by the burning of sixteen inches of magnesium ribbon at a distance of six inches. I developed with pyro-ammonia. An inspection of the photograph will show a distinct image of the Queen's head.

On repeating the experiment with fifteen inches of magnesium ribbon at six inches, but without the use of the cedar board, the part of the plate surrounding the coin was solarised, whilst the part underneath was over-exposed, so that no trace of the image was visible.

I then repeated the last experiment, using a slow lantern-plate, and burning four inches of ribbon at nine inches distance; on development a faint image of the Queen's head was visible. Hence it is only a matter of exposure and development to produce a much better result than the one presented.

The phenomenon does not appear to be due to the varying thickness of the coin, since the impression of the reverse side has not modified the result, but rather to the different *directions* in which the penetrating rays are refracted from the irregular refracting surface on to the sensitive plate. W. SAUNDERS.

[A FAINT image of the Queen's head is quite visible upon the print received from Mr. Saunders, but it will not bear reproduction.—ED. NATURE.]

A STORY was current at Cambridge some forty years ago that an aspirant to mathematical honours replied to the question, "Construct a prism through which no ray can pass," in the terms following:—

"Take a prism of *wood*: then if no ray passes through, what was required is done. But if a ray does pass through, *paint it*."

Surely a marvellous anticipation of Röntgen's X-rays!

R. B. H.

The Stress in Magnetised Iron.

I AM glad that Dr. Chree, in his letter published in NATURE of January 23, has raised a discussion of this matter, regarding which, as he says, the most contradictory statements are to be found. For some time I have been aware that the passage referred to in my book on "Magnetic Induction in Iron" requires correction. The magnetic stress, $B^2/8\pi$, in a long rod or ring uniformly magnetised, is there spoken of as if it were of the same nature as a simple longitudinal stress of compression, producing a contraction of the length in consequence of the elasticity of the metal. Dr. Chree, if I understand him rightly, would treat it as of the same nature as a simple longitudinal stress of tension, producing an elongation of the iron.

But it now seems clear to me that both of these views are equally wrong. There is no proper comparison, in the general state of magnetised iron, with the stress in a loaded pillar or the stress in a stretched rope.

Take the case of a uniformly magnetised ring, where we have no complications due to end effects. Imagine a plane of section, and call the halves of the ring A and B. According to the first view, A is, as a consequence of the magnetisation of the ring, pushing against B, and B against A. According to the other view, A is pulling B, and B is pulling A. But if A is either pushing or pulling B, the equilibrium of B demands that some other force must act on it to balance this push or pull. No such

force exists. We cannot conceive the action at any section to be simply a stress of push or a stress of pull.

What we know from experiment is that, if the ring be actually cut in two, and a piece of, say, paper be put between the halves, the paper will be squeezed with a stress equal to $B^2/8\pi$. Also, that a pull of that amount would be required to separate the two halves of the ring.

This means that when they are separated by paper the half-ring A is pulling the half-ring B towards it, and the paper is pushing the half-ring B in the opposite direction with the same force, namely $B^2/8\pi$ per square centimetre of the section.

Of course we may, if we please, say that when there is no paper interposed, each half-ring is both pulling and pushing the other. If a mechanical analogy is wanted, it might be found by imagining a stiff tubular ring with a stretched india-rubber band inside it. Suppose, further, that when such a ring is cut through at any section the india-rubber band is not cut, but only its stiff envelope. Then if we try to separate the halves, we have to apply a force equal to the pull in the rubber band. And when the halves are allowed to come together with a piece of paper between them, they will squeeze it with the same force.

Mr. Shelford Bidwell and Dr. More have done what is equivalent to asking whether the change of length which a ring undergoes when it is magnetised can be accounted for by what I have here called the pull of the rubber band acting to shorten the stiff tube in which it is stretched, the tube being treated as having the same section and the same modulus of elasticity as the real iron ring has.

But I see no ground for treating this purely hypothetical strain as a "correction" to be applied, either one way or the other, to the observed changes of length.

The case illustrated by Dr. Chree (on p. 270) is a special one. He there considers the middle piece of a long magnetised bar, separated by actual gaps from the end-pieces from which it has been cut. To preserve the gaps, the end-pieces must be held fixed. He shows that under these conditions the middle-piece is in a state of tensile stress. So it is, but only because of the pull which the other pieces apply to it across the gaps. Make the iron continuous by closing up the gaps, and the tensile stress disappears.

To discuss the sign of the magnetic stress at all in the case of a closed ring, seems much like discussing whether a man sitting in a clothes-basket exerts a pull or a push when he tries to lift it by the handles.

J. A. EWING.

Engineering Laboratory, Cambridge, January 28.

DR. CHREE's letter in NATURE of January 23 corrects an error which it is curious has prevailed so long, and in part forestalls a communication Mr. H. Nagaoka and I had intended to make on the subject of magnetic stress. It might, however, be added that the expression $B^2/8\pi$ used by Dr. More (*Phil. Mag.*, October 1895), and originally given by Mr. S. Bidwell, for the magnetic stress causing changes of length, is incorrect also on another ground, viz. that this quantity is on Maxwell's theory the magnetic stress *in air* (where, according to the ordinary convention as to dimensions, $B = H$) and not in iron, where the expression is necessarily of a different form.

In conjunction with Mr. Nagaoka, I hope before long to discuss this subject more fully.

E. TAYLOR JONES.

University College of North Wales, Bangor, January 25.

The Astronomical Theory of a Glacial Period.

MR. CULVERWELL has pointed out to me that I am in error when I include him among those writers who think that the problem of glacial periods is to be solved by considering only the varying amounts of sun-heat at different epochs. On referring to his paper, which I had not at hand when I wrote, I find that this is the case, and that he is careful to limit his calculations as giving only the variations of temperature due to *direct* sun-heat. He also discusses, though very briefly and inadequately, the effects due to *transference* of heat from one area to another. Although willingly making this correction at his request, I am still, after another perusal of his paper, quite unable to see that it finally disposes of Croll's theory, much less of that modification of it which I have myself set forth.

ALFRED R. WALLACE.

The Fall of the Altels Glacier, September 11, 1895.

JE vous adresse aujourd'hui un travail sur l'Avalanche du Glacier de l'Altels, que vient de publier la Commission des Glaciers de la Société helvétique des Sciences naturelles et qui complète l'intéressant article de Miss Maria M. Ogilvie: "The Gemmi Disaster" (NATURE, vol. lii. p. 573).

Ce travail rédigé par Mr. Heim n'est pas tout à fait définitif en ce que plusieurs points touchant à l'histoire antérieure du glacier de l'Altels n'ont pu être résolus encore. Il serait important de tirer au clair ces points pour pouvoir déterminer avec exactitude les causes de l'avalanche du 11 sept. 1895; mais, pour cela, il nous faut des *photographies* du glacier de l'Altels prises avant l'avalanche et remontant jusqu'à quelques années en arrière si possible. Après avoir fait depuis plusieurs mois des recherches peu fructueuses à cet égard je prends la liberté de m'adresser à vous, Messieurs, pour donner quelque publicité à ces lignes. Persuadé que beaucoup d'amateurs ont photographié l'Altels de l'W., ou du N.W., je les prie de bien vouloir me communiquer leurs épreuves, en indiquant la date (au moins le mois et l'année) à laquelle la photographie a été prise.

En vous remerciant d'avance de votre obligeance, je vous prie, Messieurs, d'agreér l'assurance de ma considération distinguée.

LÉON DU PASQUIER.

Secrétaire de la Commission des Glaciers.

Neuchâtel, le 21 janvier.

Remarkable Sounds.

IN Major Head's "Forest Scenes" (London, 1829, p. 205), I have found the passage already quoted by Mr. C. Tomlinson (p. 78, *ante*), subjoined with this phrase: "It being, in real fact and without metaphor, the voice of winds imprisoned on the bosom of the deep." In a similar manner, Olaus Magnus describes the similar sounds thus: "Mais es lacs Septentrionaus gelés, on oit sous la glace une tempête aussi horrible, à raison des vens enfermés sous la glace, qu'on fait d'un tonnerre provenant de la grâde épesseur des nuës." ("Histoire des pays Septentrionaus," Paris, 1561, fol. 21, *b*).

Sebastian Münster, in his article on Iceland, says:—"Car la glace divissee par loppins et brisee en plusieurs parties tourne à l'entour de ceste isle l'espace de huyt moys, et se froisse de si grande impetuosité contre le rivage, qu'elle rend un son horrible et espouantable, et semble advis que ce soit le gemissement ou brayement d'une voix humaine. Cela fait que les plus idiotz croyèt que les âmes des hommes sont la tormentees de froid." ("La Cosmographie universelle," Basle, 1552, p. 1051.) Against this error Arngrimus Ionas writes, but at the same time he admits that "this ice at sometimes by shuffling together maketh monstrous soundings and cracklings, and agaìne at sometimes with the beating of the water sendeth forth an hoarse kind of murmuring." (Hakluyt, "Principal Navigation," 1599, vol. i. p. 563.)

If it be taken into consideration that so often in the volcanic craters and thermal springs[1] man found the types of the perpetual Abode of Fire, a suggestion would seem quite reasonable that the so-called "Cold Hells" of the Buddhists[2] and the Tauists[3] had been the outcome more or less of such dreary, icy sounds.[4]

KUMAGUSU MINAKATA.

January 31.

The Antiquity of the Finger-Print Method.

IN my letter on this subject that appeared in NATURE (vol. li. p. 199, December 27, 1894), I have suggested that the ancient Japanese usage on divorce-papers of the finger-marks was probably adopted from the Chinese "Laws of Yung-Hwui"

1 *Cf.* Hardy, "Manual of Buddhism," second edition, p. 27. I remember a note in NATURE about the Indian confusion of thermal springs with the hell, but at the present moment cannot refer to the number and page.

2 See Beal, "A Catena of Buddhist Scriptures from the Chinese," 1871, p. 36.

3 See "Twan Ching-Shih, Yu-yang Tsah-tsu," Japanese edition, tom. ii. fol. 3, *b*.

4 Indeed, according to Münster, the Icelanders of old believed that their hells were in both the Hecla and the ice.

(*circa* 650-55 A.D.), issued under the reign of the third emperor of the Tang. As these "Laws," however, are nowadays lost,[1] I had but little hope to investigate further the matter. However, elsewhere a passage has lately been found, giving confirmation to my view that the Chinese usage of the finger-prints for identification was current in the time of the same dynasty of Tang.

In the Arabian "Relation des Voyages" (translated by Reinaud, Paris, 1845, pp. 42-43), the merchant Sulaiman, who made several voyages to China and India in the middle of the ninth century A.D. (the time in which the above-mentioned dynasty in China was going to decline), tells us as follows: "Les Chinois respectent la justice dans leurs transactions et dans les actes judiciaires. Si un homme prête une somme d'argent à quelqu'un, il écrit une billet à ce sujet; l'emprunteur, à son tour, écrit un billet, qu'il *marque avec deux de ses doigts réunis, le doigt du milieu et l'index.*[2] On met ensemble les deux billets. On les plie l'un avec l'autre, on écrit quelques caractères sur l'endroit qui les sépare, en suite, on les déplie et on remet au prêteur le billet par lequel l'emprunteur reconnaissait sa ditte. Si, plus tard, l'emprunteur nie sa dette, on lui dit: 'Apport le billet du prêteur.' Si l'emprunteur prétend n'avoir point de billet, qu'il nie avoir écrit un billet accompagés de sa signature et de sa *marque*, et que son billet ait péri, on dit à l'emprunteur qui nie la ditte: 'Déclare par écrit que cette ditte ne te concerne pas; mais, si, de son côté, le creancier vient à prouver ce que tu nies, tu recevras vingt coups de bâton sur le dos, et payeras une amende de vingt mille (fakkoudj) de pièces de cuivres.'"

February 3. KUMAGUSU MINAKATA.

Earthquake of January 22.

ON the morning of January 22 a shock of earthquake was felt throughout Northern Switzerland, and at many places in Southern Germany from Ulm to Strassburg. At Basel the shock was strong enough to awaken many persons, and a crackling noise was heard by almost all observers. The direction of the shock appears to have been from north-east to south-west. The seismometer at the Bernoullianum Observatory indicated 46 min. 16 sec. after midnight (mean European time). According to newspaper reports, the shock was more severely felt in the neighbourhood of Freiburg than here.

A very slight shock occurred also on January 1, 6h. 38m. 54s. in the morning. ALBERT RIGGENBACH.

Basel.

MAGNETIC INFLUENCE OF THE PLANETS.[3]

AN attempt to discover a direct magnetic influence emanating from the planets is described in "Magnetismus der Planeten," by Ernst Leyst. For this purpose the author makes use of the observations taken at St. Petersburg and Pawlowsk during the years 1873-1889, and calculates the average magnetic declination for the days at which the planets are at their greatest and least distance from the earth; also for those days at which the planets are at their greatest eastern and western elongation. The numbers so obtained show certain regularities, which are considered sufficiently marked to indicate a true effect of the planetary configurations. According to the tables given, the declination is increased by 0·2 minutes of arc when Venus is nearest, and is diminished by 0'·32 when it is furthest away. Mercury acts in the opposite direction, diminishing the declination by 0'·29 when it is nearest, and increasing it by 0'·20 when it is furthest. The backbone of an inquiry like this ought necessarily to be found in a careful discussion as to how far an accidental combination of figures could account for the apparent effect. The magnetic declination is subject to so many changes which to us seem accidental, that if we take a certain number out of the whole series of daily averages, they must necessarily show deviations. The whole question then turns on the discussion whether the effects found by Mr. Leyst are sufficiently large and regular to be considered as real. This part of the subject is, unfortunately, treated in an insufficient manner, and, for this reason, the author has not in my opinion made out his case.

We may, however, from Mr. Leyst's numbers, draw the conclusion that even if the effect is a real one, it cannot, as the author considers, be due to an ordinary magnetic force depending in its magnitude on the distance of the planets. Within a few days of conjunction that distance does not vary appreciably, and Mr. Leyst should therefore get more trustworthy results by taking account not only of the days of conjunction, but of a group of days immediately surrounding the configurations. The necessary data are supplied by Mr. Leyst, and it appears that taking Mercury, for instance, the diminution of declination is reduced from 0'·29 to 0'·20 when the preceding and following days are taken into account; while when five days altogether are considered, there is a further reduction of the effect to 0'·15, and when a month is taken, in the middle of which the inferior conjunction lies, there is only a deviation of 0'·08 from the average declination. The other planets show the same fact. The average effect of all the planets amounts to 0'·33, which is reduced to 0'·26, 0'·17, and 0'·08 when the three days, five days, and the month nearest to conjunction are taken into calculation. If the effect is a real one, it must be due to some other cause than an ordinary magnetic action, for it practically vanishes two days before or after conjunctions, when there is very little change in the relative positions of sun, planet, and earth. Mr. Leyst himself draws attention to the rapid diminution of the supposed planetary influence within a few days of conjunction, but considers it to be an argument in favour of his view.

The amplitude of the diurnal variation is discussed; and here, of course, also a planetary effect is found, which, curiously enough, is greater for Neptune and Uranus than for Venus and Mercury. The "probable error" of the result is considered, and is calculated to exceed the supposed effect in the case of Mercury, Mars and Saturn, and to amount to about two-thirds of the effect in the case of Venus, Uranus and Neptune. The author draws the conclusion that the planetary influence is "certain" for the three latter planets and Jupiter.

It is hardly necessary to follow the author further in the complicated results he deduces, by separating what he calls the "primary" and "secondary" extremes, the primary and secondary amplitudes, and the irregular and periodic part of the diurnal variation; the primary and secondary quantities being affected in opposite directions by the mischievous Mercury. In fairness to the author, it must be stated that some of the effects of that planet are found to be in the same direction when the whole period of fifty synodic revolutions is divided into two, which are separately considered. Nevertheless, a careful perusal of Mr. Leyst's work leads to the conclusion that he has not proved his case. Among the many improbabilities of magnetic influences which are hanging over us, that of a planetary effect may for the present be set aside.

ARTHUR SCHUSTER.

1 K. Konakamura in "Nipon Rikishi Hyôrin," Tôkyô, 1893, vol. vi. p. 24.

2 In a translation by E. Renaudot (Paris, 1718, p. 33), and thence in Pinkerton's "Collection," London, 1811, vol. vii. p. 192, this sentence is rendered thus: "When any person commences a suit against another, he sets down his claim in writing, and the defendant writes down his defence, which he signs, and *holds between his fingers.*" Here no mention is made of finger-marks; instead of it a meaningless clause is given. Reinaud says Renaudot committed errors in his version ("Introduction," p. ii.), and the present case is apparently one.

3 "Über den Magnetismus der Planeten," von Ernst Leyst. ("Repertorium für Meteorologie," vol. xvii. No. 1. St. Petersburg, 1894.)

THE STORY OF HELIUM.[1]

PROLOGUE.

DURING the last decade, as most of you know, our literature has been enriched by a recrudescence of the short story, generally dealing with very modern human affairs of various kinds from many different standpoints.

But these modern stories, and others that might be referred to, are not the only ones now available. During the last sixty years Egypt, Babylonia, and other countries which might be named, now here and now there, have supplied us with other stories—most precious indications which enable us to study, into a far-reaching past, the beginnings of man's history. These stories, as you also know, were not very easily deciphered—they were all of them hidden away in strangest script; but the hieroglyphics and cuneiform characters, which at first seemed to have absolutely no meaning whatever, have bit by bit been unravelled by the genius of linguistic explorers, until at length we may say that the students of Archæology are in possession of more or less complete histories of the most ancient peoples of the world.

All these histories have not yet been completely written; but my point is that they have been begun, and that even for the beginning of them the greatest skill has been required to transmute the strange hieroglyphics which were first employed by ancient peoples into modern equivalents, so that we can understand what they wished to convey. Here we are in presence of man's earliest attempt at any language; but the story which I, your President, have to tell you to-night, has a very different origin to this, for the reason that, although it is a story, and written, it is true, in hieroglyphics, the hieroglyphics are of nature's invention, and not man's.

The story or fairy tale of science, which has placed us in possession of the most precious truths regarding every star which shines in space, is a story written in nature's hieroglyphics in every ray of light which reaches this planet of ours from the tiniest star.

Now, of course in the hour at my disposal to-night it is impossible for me both to tell you a story, and spend much time upon the alphabet in which the story is written, but there are just one or two words about the alphabet that may be useful. One key to these hieroglyphics, this light story, which is hidden in every ray of light, is supplied to us by the rainbow, which teaches us that the white light with which nature bountifully supplies us in sunlight, is composed of rays of different kinds or of different colours. Many of you know that there is an almost perfect analogy between these coloured lights and sounds of different pitches.

The blue of the rainbow may be likened to the higher notes of the key-board of a piano, and the red of the rainbow, on the other hand, may be likened to the longer sound waves, which produce the lower notes; and as we are able in the language of music to define each particular note, such as B flat and G sharp, and so on, so in these celestial hieroglyphics we are enabled to do exactly the same thing with perfect definiteness, by considering the wave-length of the particular colour with which we have to deal, so that having these wave-lengths we may determine the quality of every kind of light which reaches the human eye, whether from a terrestrial light source, the sun or any other celestial body, including the shooting stars which some of us are hoping to see to-night.

Well, the result of the study of this hieroglyphic language has been that we can in that way determine the chemical source of every light of different colour which can be thus examined in any celestial body, provided always we can obtain the same light-note from some terrestrial substance when we experiment upon them at temperatures high enough to set them glowing in our laboratories. We can determine therefore, by such means, whether in different parts of space we have the same chemical substance, or whether in different stars we are dealing with substances perfectly and completely distinct.

Imagine these hieroglyphics, then, more or less translated, on the principle I have indicated to you, by the labours of Kepler, Newton, Fraunhofer, and other later workers; so that in the case of anything shining anywhere, we can eventually find out something about its chemical and its physical constitution.

Another part of the prologue, before I begin my first chapter, brings us to another line of study, that is to say, the telescopic and visual observations of heavenly bodies.

I take you back to the year 1706, when there was a total eclipse of the sun, visible in Switzerland, and there was one Stannyan, who gave an account of what he saw at Berne. After describing the phenomena of the eclipse he wrote, referring to the sun: "His getting out of his eclipse was preceded by a blood-red streak of light." Of course, in the prephotographic days no autobiographical record of that particular eclipse was obtainable, but we possess photographic records of other similar later eclipses, which may be taken as representing what Stannyan saw, for, in all, the blood-red streak referred to by him has been seen.

The phenomena photographed in all eclipses now-a-days indicate to us Stannyan's observation, for in all, certainly the sun, in getting out of his eclipse, is preceded by a blood-red streak of light, which we now know to represent one of the solar envelopes to which I gave the name of chromosphere in 1868.

Here then ends the prologue, and I begin the first chapter of my story.

CHAPTER I.

In the year 1868, the new alphabet to which I have referred was first utilised in endeavouring to unravel the message which was conveyed to us by a most interesting eclipse observed in India. The "blood-red streak" was now subjected to minute analysis, because practically the spectroscope was now first utilised. The diagrams will indicate the kind of record with which we have to deal in studying these celestial hieroglyphics. We are in one part dealing with the long waves of light, the red; we are in the other dealing with the shorter waves of light, the blue. The work done in that eclipse is indicated by the bright lines—the hieroglyphics—which, when translated as they have been, describe for us the chemical nature of the particular stuff in the sun, which made him put on a blood-red appearance "on his getting out of his eclipse." Taking the notes in the light scale which are lettered in the ordinary spectrum of light, chiefly sunlight, in order that they may be easily recognised and remembered, we learn the particular qualities of the light emitted by the blood-red streak.

We have one quality represented by the line D, another at C, and another at F. Hence the observers in 1868 could tell us very much more about the particular chemical substances which were present in that blood-red streak than Stannyan could, because spectroscopy had not been invented in his day. According to the diagram (Fig. 1), one of the lines is in the position of D. One observer said it was "at D, or near D," and almost the whole of my story depends upon that distinction.

Soon after this eclipse was observed in India, a method, long before suggested, of studying the blood-red streak surrounding the sun without waiting for an eclipse was brought into operation.

By this method it was quite easy to make observations, whenever the sun was shining, perfectly free from any of the difficulties attending the hurry and the worry and the excitement of an eclipse, which lasts only a few seconds.

Further, as the method consists of throwing an image

[1] Presidential Address, Vesey Club, Sutton Coldfield, November 12, 1895, by Prof. J. Norman Lockyer, C.B., F.R.S.

of the sun, formed by a telescope, on to the slit of a spectroscope, so that the spectrum of the sun's edge and of the sun's surroundings can be seen at the same time, exact coincidence or want of coincidence between the bright and dark lines can be at once determined. I may

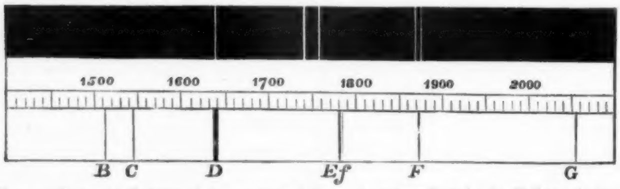


FIG. 1.—Pogson's diagram of the spectra of the sun's surroundings in the Eclipse of 1868. The bright lines seen are shown in the upper part of the diagram; the chief lines in the solar spectrum, red to the left, blue to the right, are shown in the lower part.

remind you that during an eclipse this is not possible, as the ordinary spectrum of the sun, with its tell-tale dark lines, is invisible because the sun, as we ordinarily see it, is hidden by the moon.

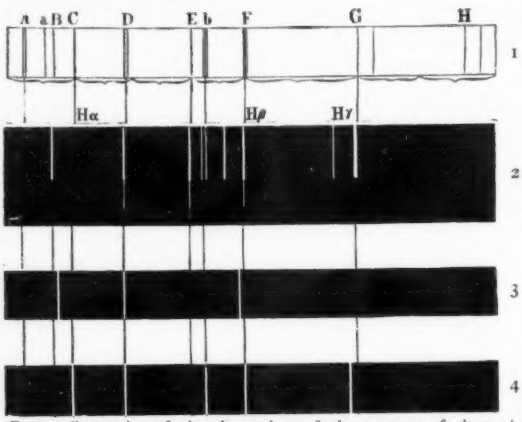


FIG. 2.—Summation of the observations of the spectrum of the sun's surroundings in the Eclipse of 1868. (1) Solar spectrum showing the position of the chief lines (2) Rayet's observations of bright lines. (3) Herschel's observations of bright lines. (4) Tennant's observations.

Working, then, under such very favourable conditions, it was seen that there was certainly a red line given by this lower part of the solar atmosphere coincident with the very important line in the solar spectrum which we call C.

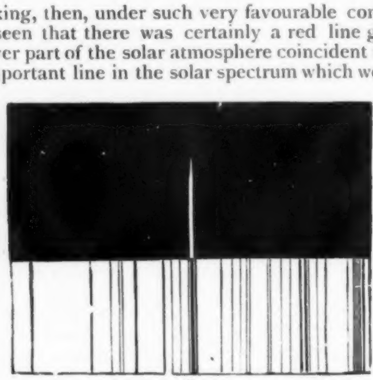


FIG. 3.—The exact coincidence of the red line with the dark line C determined by the new method.

Another part of the spectrum in the blue-green was examined, and there again it was seen that the parts outside the sun gave us a bright line exactly in the position of the obvious dark line in the solar spectrum which is called F; so that with regard to those two most important lines, there was no doubt whatever that we were dealing with the substance which produces these dark lines in the solar spectrum.

Fig. 5 is a diagram of the yellow, or rather the orange, part of the solar spectrum, showing two very important lines, which are called the lines D, due to the metal sodium, the investigation of which was just as important in solving these celestial hieroglyphics as the Rosetta stone was important in settling the question of the Egyptian ones.

Pogson, in referring to the eclipse of 1868, said that the yellow line was "at D, or near D." You will see from this diagram that the new method indicated that "near D" was the true definition. The line in this position in the spectrum, unlike the other two lines which I have indicated, has no connection at all with any of the dark lines in the ordinary solar spectrum. We were therefore perfectly justified in attaching considerable importance to this divergence in the behaviour of this line, taking the normal behaviour to be represented by the two strong lines in the red and the blue-green. The new line was called D^3 to distinguish it from the sodium lines D^1 and D^2.

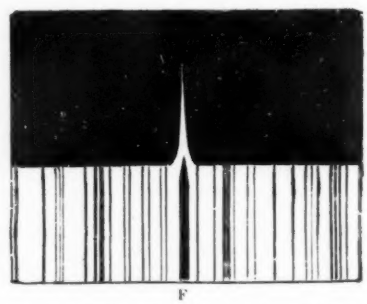


FIG. 4.—The exact coincidence of the blue-green line with the dark line F.

A considerable amount of work was done with regard to the yellow line. It was found that there was no substance in our laboratories which could produce it for us, whereas in the case of the line D we simply had to burn some sodium, or even common salt, in a flame to produce it, and the other lines in the red and the blue-green were easily made manifest by just enclosing hydrogen in

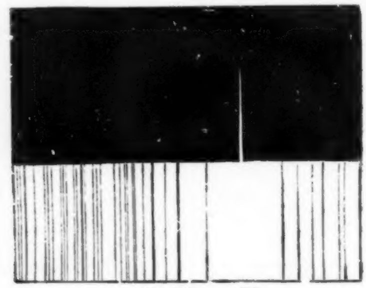
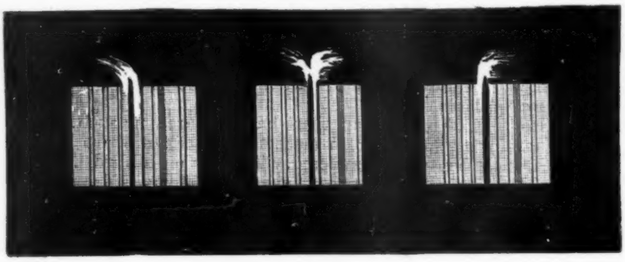


FIG. 5.—The want of coincidence of the range line, D^3, with the dark lines D^1 and D^2.

a vacuum tube, and passing an electric current through it, or observing the spectrum of a spark in a stream of coal-gas.

Now at the first blush it looked very much as if this

line was really due to the same element which produced the others at C and F, and it was imagined that the reason we did not see it in our laboratories was because it was a line which required a very considerable thickness of hydrogen to render it visible. That was the first idea, and Dr. Frankland and myself found that there was very considerable justification for this view, because a simple calculation showed that the thickness of the solar atmosphere, which was producing that yellow line under the conditions which enabled us to see it in our instruments by looking along the edge of the sun, was something like 200,000 miles.



A B C

FIG. 6.—Changes of wave-length of the F hydrogen line when a solar cyclone is observed. A, the change towards the red indicates the retreating side of cyclone. C, the change towards the blue indicates the advancing side. B, the whole cyclone is included in the width of the slit, and both changes of wave-length are visible.

Hence, in order to get a final decision on this point, there was nothing for it but to tackle the question from a perfectly different point of view, and the different point of view was this. The work had not gone on very long before one found minute alterations in the positions of these lines in the spectrum; the blue line, for instance, might sometimes be slightly on one side, and sometimes on the other of its normal position. Further work showed that in these so-called "changes of wave-length" we had a precious means of determining the rate of movement of the gases and vapours in the solar atmosphere.

Fig. 6 indicates how these changes of wave-length are shown in the spectroscope. The lines are contorted in both directions, and sometimes to a very considerable extent, indicating wind-movements on the sun, reaching, and sometimes exceeding, 100 miles *a second!*

Well, then, you see we had here a means of determining whether the yellow line was produced by the same gases which gave the red and blue lines, because if so, when we got any alteration in the position of the red and blue lines, which always worked together, we should get an equivalent alteration in the position of the yellow one.

I found that the yellow line behaved quite differently from either the red or the blue line; so then we knew that we were not dealing with hydrogen; hence we had to do with an element which we could not get in our laboratories, and therefore I took upon myself the responsibility of coining the word helium, in the first instance for laboratory use.

This kind of work went on for a considerable time, and what one found was, that very often in solar disturbances we certainly were dealing with some of the lines of substances with which we are familiar on this earth; but at the same time it was very remarkable that when the records came to be examined, as they ultimately were with infinite care and skill, it was found that not only did we get this line in the yellow indicating an unknown element associated with substances very well known, like magnesium, but that there were many other unknown lines as well. Within a few months of my first observations, several new lines about which nothing was known were thus observed. The place of this orange line I determined on October 20, 1868. Among many other lines behaving like it, two at wave-lengths 4923 and 5017 were discovered in June 1869, and afterwards another at 6677, while Prof. Young noted another in September 1869, at 4471. He wrote:

"I desire to call special attention to 2581·5 [Kirchhoff's scale], the only one of my list, by the way, which is not given on Mr. Lockyer's. This line, which was conspicuous at the Eclipse of 1869, seems to be *always present* in the spectrum of the chromosphere. . . . It has no corresponding dark line in the ordinary solar spectrum, and not improbably may be due to the same substance that produces D^3."

This same line was noted also by Lorenzoni, and named *f*.

Then with regard to solar disturbances. Let me refer in detail to a diagram indicating some results arrived at by the Italian observers. We are dealing with the spectroscopic record of two slight disturbances in a particular part of the sun's atmosphere. The spectroscope told us that in that region there was a quantity of the vapour of magnesium which was collected in that place. Then we find that another substance, about which we again know nothing whatever, is also visible in that region, and then we get the further fact that in those particular disturbances we get four other spectral lines indicated as being disturbed, and of those four lines we only know about one.

In that way it very soon became perfectly clear to those who were working at the sun, that in all these disturbances, or at all events in most of them, we were dealing to a large extent with lines not seen in our laboratories when dealing with terrestrial substances; this work went on till ultimately, thanks to the labours of Prof. Young in America, we had a considerable list of lines coming from known and unknown substances which had been observed under these conditions in the solar chromosphere, and Prof. Young was enabled to indicate the relative number of times these lines were visible. For instance, the lines which are most frequently seen under these conditions he indicated as represented by the number 100, and of course the line which was least frequently

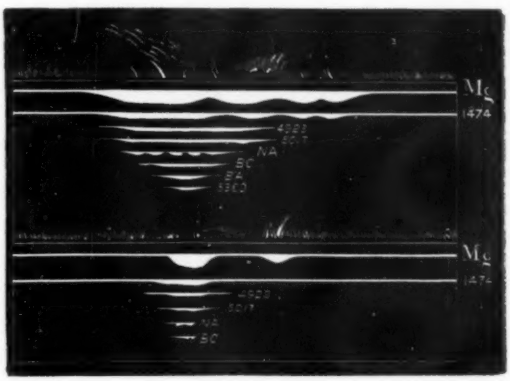


FIG. 7.—Tacchini's observations of two slight solar disturbances showing the height to which the layers of the different gases extend. Magnesium vapour is highest of all, and is furthest extended; next comes a gas of still unknown origin, indicated by a line at 1474 of Kirchhoff's scale, and so on.

seen would be represented by 1; and therefore from these so-called "frequencies" we got a good idea of the number of times we might expect to see any of these disturbance-lines, when anything was going on in the sun.

It was this kind of work which made Tennyson write those very beautiful lines:

> "Science reaches forth her arms
> To feel from world to world"

And then he added:

> "and charms
> Her secret from the latest moon."

I mention this because Tennyson, whose mind was saturated with astronomy, had already grasped the fact that what had already been done was a small matter compared with what the spectroscope could do; and now the prophecy is already fulfilled, for by means of the spectroscopic examination of the light from the stars we can tell that some of them are double stars, that is to say, in poetic language, stars with attendant moons. Although we can thus charm the secret from each moon by means of the spectroscope, to see the moon it would require a telescope not 80 feet long, but with an object-glass 80 feet in diameter, because the closer two stars are together the greater must be the diameter of the object-glass, independently of its focal-length and magnifying power.

(To be continued.)

THE CAMBRIDGE NATURAL HISTORY.[1]

THE second volume of this series (vol. v.) to make its appearance is devoted, with the exception of articles on the Prototracheata (pp. 3–26) and Myriapoda (pp. 28–80), to the Insecta, which will occupy also the whole of vol. vi.

Mr. Sedgwick gives a concise account of *Peripatus*, which, being derived mainly from his own well-known papers, does not call for extended notice; the descriptions of anatomy and development are written in a somewhat technical style, but are not over-elaborated. If it were thought necessary to reprint an easily-accessible list of the known and doubtful species, it should certainly have been revised. No records are noted since 1888; *P. juliformis* is given as a doubtful species, whereas at most it is incompletely characterised, and *P. trinidadensis* actually figures as "n. sp." A map, serving as frontispiece, shows the distribution; but the records from Peru and Chili seem scarcely to justify the inclusion of so much of the arid western littoral of South America.

Myriapoda are not a fascinating subject, but Mr. Sinclair's article, though slight and somewhat wanting in style, gives many particulars of interest about them. The author is clearly a morphologist rather than a systematist, and has made a serious mistake in employing a classification so antiquated as that of Koch, who knew little of extra-European forms, and whose characters, if rightly transcribed, are far from accurate. Mr. Sinclair prefers to disregard the work of systematists who have dealt with separate families only; but a system by Bollman of the whole class (or classes, according to some specialists), published in 1893 in *Bulletin* xlvi. of the United States National Museum, has been overlooked. In the section on development no mention is made of the reversal of the embryo referred to on p. 216 of the work. This was a matter for the editors, as is indeed the whole subject of embryology. The details of early embryonic development are so similar, that there is a risk of useless repetition and of insufficient stress on points of difference unless some co-operation is instituted among contributors. The figures of species are copied from Koch's "Die Myriapoden," and, though the fact is not stated, that of *Cermatia variegata* was drawn from an example which had lost six pairs of legs!

In no branch of zoology has the influence of modern morphological and biological research been of slower growth than in entomology; the subject is so complex, so dominated by taxonomy and an unwieldy literature, that few entomologists have the energy to leave their immediate field of study in order to gain any general knowledge of the natural history of insects. For this the responsibility rests largely with the authors of the many text-books on entomology, who for the most part have been content to follow an antiquated method, basing their work on a substructure of classification, and ignoring families of the highest interest from all points of view except those of the collector and systematist, in order to fill their pages with a tedious procession of names and useless details.

For many years there has appeared no such valuable or original work on insects as this of Dr. Sharp promises to be, when completed. The author has rid himself of the chains of the systematist, and has endeavoured, in the most thorough and catholic spirit, to give a just view of the many points of interest, whether in structure, development or habits, which attach to this, the richest class of the animal kingdom.

FIG. 1.—Front of head of *Copiophora cornuta*, female. Demerara.

In such a task, one does not look for novelty in facts or theories, though there is ample evidence of independent thought and investigation. It is in the selection and treatment of subjects that Dr. Sharp's originality is shown, and in these the book stands absolutely alone. It is a real and new pleasure to read a work of so broad a scope, in which so much is entirely unknown except to the closest students of recent literature, in which families such as *Thysanura*, *Hemimeridæ*, *Embiidæ*, or *Termitidæ* are adequately treated, and where due regard is paid to the writings of students such as Brauer, Grassi, or Cholodkowsky.

Though familiar insects are by no means neglected, and much that is interesting and new is said even about the earwig and cockroach, the number of strange and rare forms discussed is quite extraordinary. No one knows the literature of the subject better than the author,

[1] "Peripatus, Myriapods, Insects." By A. Sedgwick, F. G. Sinclair, and D. Sharp. Pp. xii + 584. (London: Macmillan and Co., 1895.)

who has ransacked it in a way that it would have been hopeless to attempt without the preparation gained by many years' work in connection with the *Zoological Recor*..

His style is graphic and pleasant and, even when he is most erudite, he is never dry. Nevertheless, the book will appeal with more force to the expert than to the beginner. The definitions are often vague, notably in the chapter on external structure. This arises less from any fault in the author's method than from a reluctance to give definitions which do not embrace all known variations from a common type. To those who can read between the lines this vagueness presents no difficulty, but we suspect that the general reader will fail sometimes to get a clear conception of the subject. The insufficiency of our present knowledge is a favourite and over-emphasised text of the author, who does not conceal his dislike both to generalisation and the acceptance of morphological axioms. Though he rarely expresses his opinion, even on matters where it would be most welcome, in a remarkable footnote (p. 91) he suggests that the wings, equally with the legs, are "appendages." He might be thought to protest against the limitation of the term to a single homologous series, but his remarks on the possibly duplex origin of the thoracic somites tend to negative this view. That there can be any homology between the

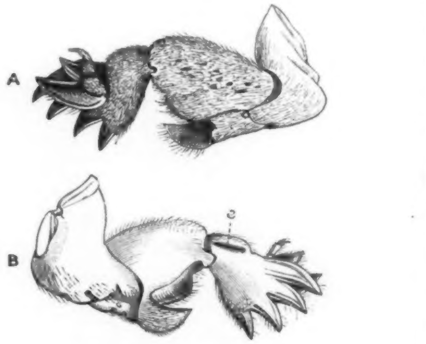


FIG. 2.—Front leg of the mole-cricket. A, outer; B, inner aspect; *c*, ear-slit.

legs and wings is a dangerous suggestion to hint at in a work not intended solely for critical readers.

Where so much is novel, it is impossible, within the limits of a notice, to touch on even a small part of the subjects dealt with in the work: the development of the antennæ in *Forficulidæ*, the mimetism of *Mantidæ*, the economy of the Termites, the insects of the coal-measures, the formation of galls, these are examples of many topics discussed in the light of the most modern researches.

The chapters in this volume treat of external and internal structure, development and classification, and, out of the nine orders proposed, of the Aptera, Orthoptera, Neuroptera, and part of the Hymenoptera (Sessiliventres and Parasitica). The remaining orders will occupy vol. vi. of the series.

Of the chapter on development the most suggestive part is that on metamorphosis. Dr. Sharp urges that this phenomenon is yet very imperfectly understood, owing to our ignorance of the underlying physiological changes, and that nothing can be postulated about it without taking into account the processes of embryonic development and of such deviations from the normal course as hypermetamorphosis and the extraordinary changes undergone, for example, by parasitic Hymenoptera. The view that ecdysis is correlated solely with growth, is rejected in favour of Eisig's suggestion that it is a means of excretion.

It follows that metamorphosis is here regarded as of subordinate importance in classification, and though the usual definitions of its extent are rejected, no alternative scheme on a physiological basis is proposed. It is quite unlikely that entomologists will adopt the author's extreme views, but these pages, the result of much thought, will come as a surprise to those who have a comfortable belief in the fixity of the accepted degrees of metamorphosis, degrees which, as Camerano has said, are purely scholastic.

Sexual phenomena, such as heterogamy or dimorphism, are treated only in connection with the forms which exhibit them, but at the end of the chapter on internal anatomy there is a short paragraph on parthenogenesis and pædogenesis. It is nowhere indicated that the latter is an extreme form of the more general phenomenon of neotenia, alluded to under the *Termitidæ*.

Little importance is attached to the threadbare question of the division of the class into orders, and in the arrangement here adopted for convenience and without discussion the undue complexity of some recent systems has been, we think, wisely abandoned. Nine orders are indicated: the Neuroptera include the Pseudoneuroptera and Mallophaga, and two small orders only are kept separate, the Aptera (for Thysanura and

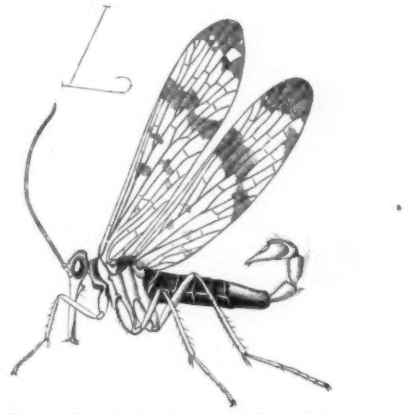


FIG. 3.—*Panorpa communis*, male. Cambridge.

Collembola) and the Thysanoptera. The extension of Neuroptera to its original limits is in accordance with the views of some recent writers, for example, Brongniart. But with respect to the Aptera, which is coterminous with Brauer's Apterygogenea, attention has not been paid to Grassi's recent admission that the Thysanura, in common with all existing insects, may be derived from winged forms. They present many primitive features, but these are compatible with their place as the lowest Orthoptera, the homology of the abdominal styles with the legs having been lately seriously questioned. Though the inclusion of the Mallophaga in Neuroptera is not new, it is a pity that no reasons are given for an association which, however sound, is hard to appreciate.

Of the variety of subjects in the chapters on the separate orders, we have already spoken. The Hymenoptera, being more homogeneous, are treated in somewhat less detail than the others. A figure of some of the manifold forms assumed by the petiolate abdomen would have been welcome, and among structural points there is no reference to the strange nipper-like front tarsi of *Gonatopus*.

In the chapter on *Acridiidæ*, no mention is made of the fact, important in connection with the migratory

instinct, that the permanent homes of locusts are situate in sterile land, and it would have been well to remove the common misconception that the winged swarms are the chief enemies of the agriculturist; it is against the march of the larvæ, here graphically described in the words of an eye-witness, that he has specially to guard.

There are a few inaccuracies and examples of loose expression, of which one or two may be mentioned. The author states that "the anterior portion of the intestine is the smaller, and is frequently spoken of as the colon," whereas elsewhere he alludes specifically to the ileum, which is often distinguishable. Certain glands in connection with the uterus are twice called the "serific," once the "sebific" glands; which term is meant is not clear. He adapts the term "instar" from Fischer to denote the form of an insect during a "stadium," that is, between consecutive ecdyses, but elsewhere he speaks not quite consistently of different instars as connoting a change of form, as well as of stadium. The reference to Chatin's views on the morphology of the mandible, would lead one to suppose that Chatin had found articulated mandibles in *Embia*. This is not the case; Chatin merely compared the parts of the mandibulate mass with the joints of the maxilla, and did so for many mandibulate insects and not *Embia* alone.

The standard which this work sets, if followed throughout the series, will leave the "Cambridge Natural History" without a rival. The book is one to be read not merely by entomologists, whose work it will certainly influence, but by general zoologists. The attention paid to insects in zoological teaching is quite disproportionate to the place they occupy in the animal kingdom; but hitherto zoologists have had no guide to what is best worth knowing on the subject.

The volume presents all the beauty and finish which mark its precursor in the series. The illustrations, original or from original papers, are admirable; some of these we are permitted to reproduce. Fig. 120 has been drawn in an inverted position and is not quite clear, and a much better figure of *Cylindrodes* than the one given, accompanies Gray's original account of the genus.

W. F. H. BLANDFORD.

MEDICAL APPLICATIONS OF RÖNTGEN'S DISCOVERY.

THE new photography has received the official recognition which is usually given to scientific discovery in Germany. Prof. Röntgen has been honoured by the Emperor, and the Prussian Minister of War has caused experiments to be made in order to discover whether the method can be applied successfully to army surgery. A series of photographs of bone injuries have shown so clearly the nature of the wounds and the position of imbedded projectiles that it has been determined to carry on the experiments on a larger scale.

Medical science seems likely to benefit much by the application of Prof. Röntgen's discovery. The *British Medical Journal* thinks, as an aid to diagnosis of obscure fractures and internal lesions generally, the new photography will be of great value. From our contemporary we note that already a beginning has been made in this direction, and Prof. Mosetig, of Vienna, has taken photographs which showed with the greatest clearness and precision the injuries caused by a revolver-shot in the left hand of a man, and the position of the small projectile. In another case the same observer detected the position and nature of a malformation in the left foot of a girl with entire success. Prof. Lannelongue, of Paris, has also been successful in photographing some of his cases in his ward at the Trousseau Hospital, and, assisted by MM. Oudin and Barthélemy, has submitted to the Academy of Sciences several negatives of human limbs. One of them represented a diseased thigh-bone. The destroyed central portions had been penetrated by the light, forming white blotches on the plate. Another photograph was that of a tuberculous affection of the bone in a child's hand. The disease had been diagnosed, but photography brought complete confirmation to the diagnosis.

The Berlin correspondent of the *Lancet*, referring to the practical use being made of the discovery, says in one case a finger which had sustained a compound fracture, and from which a sequestrum had been removed, was photographed by the new process, and the regeneration of the bone was thereby made visible. In another case the position of a piece of glass embedded in the tissues was ascertained by the same method. Similar reports come from other Universities, as, for instance, from Berne, where Prof. Kocher has photographed a needle in a woman's hand; it had made its way under the skin some time ago, and had not been found by any other means.

A CONTRIBUTION TO THE NEW PHOTOGRAPHY.

NUMEROUS pictures are now being taken by means of the new method. The accompanying illustration, which we owe to the kindness of Prof. Nernst, and the original of which was made by him in the Physical-chemical Laboratory at Göttingen, represents a human hand as

photographed by means of the Röntgen rays. It will be seen that the flesh is very nearly transparent for these rays, while the bones, the gold ring, the piece of wire, and the glass tube are practically opaque. The ring and wire, which were naturally in contact with the flesh of the fingers, appear in the illustration as if suspended in the air

WILLIAM J. S. LOCKYER.

NOTES.

M. MOISSAN has been elected President of the Chemical Society of Paris.

M. ROUCHÉ has been elected Académicien libre of the Paris Academy of Sciences, in the place of the late Baron Larrey.

MR. ALEXANDER AGASSIZ, having finished his surveys of the coral-formations in the West Indies, has made arrangements to explore the Great Barrier Reef of Australia, and proposes to leave America for Brisbane, for that purpose, with a staff of assistants, early in March next.

THE valuable conchological collection formed by the late Miss Jane Saul, was bequeathed by her to the University of Cambridge, and has lately been received by the Museum of Zoology. The collection is principally remarkable for the magnificent series of the genus *Cypræa*, in which are included several species of great rarity.

OUR U.S. correspondent writes: "The announcement was made last August, that the New York Botanical Garden had received 250,000 dols. of the 500,000 dols. necessary to start it properly. Progress is now reported in raising the remaining 250,000 dols., Mrs. Esther Herrman, of New York, having contributed 5000 dols. Miss Helen Gould, sister of Countess Castellane, has given Vassar College 8000 dols. to endow a scholarship. Mr. Abram Abraham, of Brooklyn, recently empowered the President of Cornell University to purchase the Oriental library of Ernest Rénan as a gift to the University, but news has just been received that the widow of Rénan's publisher has given the library to the Bibliothèque Nationale. It is announced that the electrical exhibition to be held at New York, May 4–June 1, will be the most elaborate ever held in America. Barnard College, one of the new colleges for women, has recently raised a fund sufficient to secure it a permanent home, and will erect a $500,000 building next spring, on the corner of 119th Street and Boulevard New York, near the new site of Columbia College, with which Barnard is affiliated."

THE *Pharmaceutical Journal* states that a Committee has been appointed by Prof. Alfred Dohme, Chairman of the Scientific Section of the American Pharmaceutical Association, to direct investigations in the pharmacognosy, chemistry, biology, histology, &c., of drugs. The Committee consists of Prof. A. B. Prescott, of Ann Arbor, President; Prof. Edward Kremers, University of Wisconsin; Prof. L. E. Sayre, University of Kansas; Prof. John U. Lloyd, President of the Cincinnati College of Pharmacy; Prof. Samuel P. Sadtler, Philadelphia College of Pharmacy; and Dr. Charles Rice, Chairman of the National Committee on the Revision of the United States Pharmacopœia.

A NEW immense domain, full of interest for the naturalist and the anthropologist, is now opened for scientific exploration by the great Trans-Siberian railway. Last month the rails were laid on this line as far as Krasnoyarsk, on the Yenisei, and next summer the explorer will be able to reach by rail the banks of the Yenisei, at a distance of 3057 miles from St. Petersburg. With the cheapness of railway communication in Russia—a second-class return ticket from St. Petersburg to Omsk (2673 miles) costs about eight pounds—and the facilities opened for navigation by the great rivers running northwards, Siberia is sure to become soon a favourite field for scientific explorers.

SOME information concerning the Russian geological expedition which visited Novaya Zemlya last summer, was given by the geologist, M. Tchernyscheff, at the meeting of the Russian Geographical Society on January 2, and at the Mineralogical Society on January 8. The Matochkin Shar, which divides the great island into two parts, was visited, but could not be explored over its full length, on account of the ice stocked in its eastern portion. The expedition crossed Novaya Zemlya in the latitude of Karmakuly, and returned laden with rich geological collections. Undoubted proofs have been found of the secular raising of, at least, the southern island of Novaya Zemlya. This island is built up of Palæozoic rocks (Devonian and the "Artinsk" strata), which are covered with Post-Tertiary deposits. It bears traces of a wide glaciation which was followed by submergence, as shown by several beach-terraces, wide deltas, and lakes. At the present time it is in a period of upheaval.

UPON application of the Middlesex County Council the Home Secretary has made the following order, dated January 29: 1. "The Wild Birds Protection Act, 1880," shall apply within the county of Middlesex to the wryneck (cuckoo's mate or snake bird), swallow, martin (2), swift, bearded tit (reedling or reed pheasant), shrikes, kestrel, merlin, hobby, buzzard, honey buzzard, osprey, and magpie, as if those species were included in the schedule to the said Act. 2. The taking or destroying of the eggs of the following wild birds is prohibited within the county of Middlesex, viz. nightingale, goldfinch, lark, nightjar, woodpeckers, kingfisher, cuckoo, owls, kestrel, buzzard, honey buzzard, merlin, hobby, osprey, wryneck (cuckoo's mate or snake bird), swallow, martins (2), swift, bearded tit (reedling or reed pheasant), shrikes, magpie, wheatear, stonechat, whinchat, red start, fly catchers, sedge warbler, reed warbler, blackcap, garden warbler, wood warbler, willow warbler, chiff-chaff, white throat, lesser white throat, long-tailed tit, nuthatch, wren, gold-crested wren, wagtails (4), hawfinch, linnet, buntings (3), starling, landrail or corncrake, and coot.

PROF. IRA REMSEN describes in *Science* an interesting case of the accumulation of marsh gas under ice. It appears that a number of skaters were on a large artificial lake upon which remarkably clear ice had formed. In various places white spots were noticed in the ice, suggesting air-bubbles. Some one bored a hole through one of these white places, and applied a flame to the gas, which took fire. This led to further experiments, and it was found that, by boring a small hole, a long thin jet of flame could be obtained, and this continued for some time. The gas was marsh gas, formed by the decomposition of the vegetable matter at the bottom of the lake. Prof. Remsen remarks that this method of demonstrating the formation of marsh gas in nature is, from the æsthetic point of view, a great improvement on the usual method described in text-books, which consists in stirring a pool of stagnant water with a stick, and collecting the gas that rises to the surface. He suggests skating ponds illuminated by natural gas as among the possibilities of the future.

THE occurrence of a second period of very high barometric pressure in these islands during the month of January is noteworthy. The *Daily Weather Report* of the 28th showed that an anticyclonic area was spreading over the south-west of England, and at 11 p.m. on the 29th the high reading of 30·96 was recorded at Roche's Point, in the south of Ireland, and readings reached or exceeded 30·9 inches all over the south-western portions of England and Ireland. In London a maximum of 30·93 inches was reached, which corresponded with the reading there on the 9th of the same month. Such high readings have not occurred there since January 18, 1882 (when the barometer rose to 30·975 inches), and have been extremely rare during the last century. A peculiar feature of this high barometric pressure has been the

mildness and dampness of the weather; although some rather low temperatures were recorded by thermometers exposed to the sky, the maximum readings have reached 45° to 50° during the day-time. It will be remembered that this period last year was one of almost continuous, severe frost, which lasted until February 20.

IT was pointed out in a recent article in the *Engineer*, that the introduction of warlike stores, and their final inspection and sentence, is entirely in the hands of naval and military men. The matter is again referred to in the current number of our contemporary as follows: "The actual manufacture only is under a civilian Director-General, but, with the exception of the Small Arms Factory at Enfield, the superintendents and their assistants were still all naval or military officers, and have remained so since the reorganisation carried out by an officer of the artillery in 1887. A colonel of artillery and two captains of the same arm manage the Royal Laboratory; a captain of the Navy and a lieutenant manage the Royal Gun Factory; a colonel of engineers is responsible for the Royal Carriage Department; a colonel of artillery, a captain, and a lieutenant, are responsible for the Royal Gunpowder Factory; and a colonel of artillery manages the factory in Birmingham. The Director-General has two military assistants, one a commander in the Navy, and one a captain in the artillery, and it would thus appear that he is assisted by no less than twelve officers of the Army and Navy, and therefore if the work turned out to be bad and dear—as it is alleged to be by the writers in the *Times*—that circumstance seems to us to be a strong argument in favour of the proposition that military and naval men are unfit, from want of technical knowledge and special training as manufacturers, to carry on manufacturing operations, and confirms the view which we have expressed of the imprudence of placing important factories under such management, and thus severely hampering a competent civilian Director-General. . . . In our judgment no substantial improvement in economical management is to be looked for till there is a complete separation between the military advisers of the Director-General and the civil assistants who are charged with the actual carrying out of the work and the keeping of the accounts."

THE question of the relation of psychology to physiology, and of the line of demarcation between the two sciences, is discussed by Prof. G. S. Fullerton in the *Psychological Review* for January. Psychologists are often charged with occupying themselves in doing work which is purely physiological, and they retort by stating that most text-books of physiology include matter which belongs to psychology. The fundamental assumption of psychology is, to state Prof. Fullerton's argument, the assumption of an external physical world, and of minds which mirror it. It is the task of the psychologist, with the aid of introspection, observation and experiment, to obtain a knowledge of such minds, and to reduce their phenomena to laws. Though little is known about the changes in a nerve during a passage of a nervous impulse, the methods employed in investigating physical and chemical problems may be expected to throw some light upon them. On the other hand, argues Prof. Fullerton, psychical facts—such as sensations, perceptions, volitions—have also to be reckoned with, and one would hardly expect to study them just as the changes in a muscle during contraction are studied. Therefore he thinks that while the task of the physiologist is to investigate, by directly objective methods, the physical series of causes and effects, the psychologist studies facts of another order by the method of introspection, observation and experiment, and interpretation.

IN a recent note we congratulated those interested in astronomy upon the fact that there would be soon a total solar eclipse visible almost at our doors, and that the Orient Company, Messrs. Cook, and Messrs. Gaze were advertising special steamers to go to Norway for the benefit of would-be observers. Then we went on to say: "We notice with some astonishment, in a circular issued by Messrs. Gaze and Son, the statement that 'an official party of observers, arranged by a joint committee of the Royal Society and of the Astronomical Society, are proceeding to Norway, and will travel by the s.s. *Norse King*.' We hardly think that this statement is authoritative, for scientific committees are not in the habit of advertising their intention to patronise any particular line of steamers; and, further, astronomers usually require more than five days to adjust and set up their instruments if any work of real use to science is to be done." We have received a letter from Messrs. Gaze and Son complaining that the above paragraph is "inaccurate," and assuring us that "an official party will travel by the *Norse King*." We willingly comply with their request, pointing out at the same time that we have been guilty of no inaccuracy, and that we did not deny their statement. We are not in a position to do so because, so far as we know, the Committee has published nothing on the subject. What we said was that it was not *authoritative*, and a statement of the kind made in an advertisement cannot surely be taken as authoritative even when it is used as a decoy. In any case we trust the "official party," whether singular or plural, will have a good time; but we still hold to our opinion as to the too short interval allowed for the preliminary arrangements on the spot.

MANY attacks have been made on the six zoological regions of Sclater and Wallace, and one of the most determined of these has been the proposal of an "Holarctic" region, to embrace the circumpolar districts and adjoining lands of both hemispheres. Dr. Scharff is a supporter of this view, which has likewise been maintained with great vigour by Dr. Merriam in America. But Dr. Wallace has shown that all the facts brought forward in its favour may easily be reconciled with the more orthodox view. An essay, entitled "Étude sur les Mammifères de la Région Holarctique et leurs relations avec ceux des Regions voisines," by Dr. R. F. Scharff, has just been published as an excerpt from the *Mémoires* of the French Zoological Society. In the essay, which has been rewarded by a prize founded at the International Zoological Congress held at Moscow, Dr. Scharff commences by a discussion of the Mammal-fauna of Ireland, and traces the species now existing and recently extinct in that country to their places of origin, so far as these can be settled by geological evidence. He proceeds to Southern Europe and Northern Africa, and shows how the Mammals that now inhabit these portions of the Palæarctic region may have reached their present quarters. There is much information to be gathered from the facts brought together by Dr. Scharff, but we cannot say that he has carried the case in favour of the "Holarctic" region much further than previous supporters of that theory.

THE number just issued of the *Arbeiten aus dem Kaiserlichen Gesundheitsamte* contains an official report by Regierungsrath Dr. Rahts, on the outbreak of influenza which occurred in Germany during the winter of 1893–94. In this epidemic, the country population suffered far more severely than that of the towns, and it is interesting to note that Hamburg experienced an exceptionally light visitation of the disease, this being doubtless partly attributable to the cholera epidemic of the previous year having eliminated to a certain extent the less vigorous lives. The period of incubation appears to have varied from two to five days, and the infectious nature of influenza was again amply verified. It is pointed out that the careful disinfection of all catarrhal expectoration is of great importance in preventing the

spread of the contagion, and the successful manner in which outbreaks were restricted is ascribed to such disinfection having been carried out on the same lines as those laid down in the case of tuberculous infectious material. On the whole the report does not throw any important fresh light on this mysterious disease, and its latest appearance in epidemic form does not appear to have differed very materially from that which has characterised previous outbreaks. No reference is made to the bacteriology of influenza.

AN important and most elaborately conducted inquiry has recently been made by Dr. Lösener on the opportunity for spreading disease offered by the burial instead of cremation of infected carcases. The actual conditions attending the process of burial were as far as possible faithfully followed, both as regards the depth of the hole and the enclosure of the carcase. The duration of vitality of the various pathogenic microbes under such circumstances was found to vary very considerably. Thus typhoid bacilli only on one occasion survived the processes of putrefaction 96 days, cholera vibrios could not be detected after 28 days, tubercle bacilli lived from 95 to 123 days. Tetanus bacilli were, however, still in a highly virulent condition even after 234 days, but after the lapse of 361 days they were no longer discoverable. The bacillus pyocyaneus lived up to 33 days, and Friedländer's pneumonia bacillus 28 days; whilst anthrax germs retained their full complement of virulence during the whole year over which the investigations extended. As regards infection of the surroundings, the information is so far satisfactory, inasmuch as only in the case of anthrax germs were they discovered to have found their way to the adjacent soil and water. So admirable a barrier, however, is provided by the soil, that the earth close beneath the bottom of the hole containing the infected carcase, was in every case found to be quite devoid of pathogenic germs. The bacterial purification effected by filtration through soil has been shown by the Massachusetts experiments on sewage in which five feet of garden soil and five feet of peat were respectively used. So few microbes found their way through, that they were not attributable to the filtration itself, but rather to post-filtration sources. Of course for practical filtration purposes these materials are not available, as they work so very slowly, but the results obtained with them help to support Dr. Lösener in his reassuring views as to the hygienic aspects of burial.

A PAPER of considerable interest, contributed by Dr. F. Ahlborn to the current number of one of our best-known contemporaries, contains a novel application of rowing to biology (*Zeit. f. wiss. Zool.*, lxi., December 1895). The main object of the paper is to explain the use and meaning of the asymmetrical types of tail-fin which are so commonly met with among fishes—*e.g.* the upturned tail of the shark and sturgeon, and the downwardly extended fin of the flying-fish. Dr. Ahlborn's explanation is founded on a recent suggestion of Prof. F. E. Schulze's in regard to the tail of Ichthyosaurus, and is illustrated by comparisons presumably drawn from the author's own experiences in the art of rowing. Every tyro knows the consequences which ensue if he holds his blade too obliquely in the water. If the upper edge is inclined too much towards the stern of the boat, a brisk pull upon the handle results in the blade jumping out of the water, and the oarsman falling backwards from his seat; if, on the other hand, the blade is inclined too much in the opposite direction, it digs into the water and the oarsman "catches a crab." The relevance of these illustrations is found in the fact that the skeletal support of the asymmetrical tails of fishes is generally such that either the upper or lower border of the fin is more resistant to the pressure of the water than the opposite border, a fact which causes the fin in action to assume an oblique, instead of a vertical position. The result of such a disposition is that in those cases where the upper part of the tail is stiffer than the lower the tail in locomotion is driven upwards, as the oar is driven out of the water (heterocercal tail of shark and sturgeon); while in cases where the lower part of the tail is firmer than the upper the tail tends, in action, to assume a lower position than the rest of the body (flying-fish). The body of the animal, in fact, is made to swing vertically about a horizontal axis running through the centre of gravity: in the first group the tail becomes elevated above the head, in the second group the head becomes raised above the tail. The utility of these types of organisation becomes obvious when we reflect, with Dr. Ahlborn, upon the habits of the creatures which exhibit them. The first group consists of bottom-haunting fish, which are thus enabled to give free play to their tails while scouring the sea-bottom in search of food; the second consists entirely of surface-swimming forms which are enabled, by this beautiful adaptation of structure, to swim swiftly beneath the surface of the water without the risk of their tails emerging, and so causing inconvenience and waste of force. The tails of many air-breathing aquatic animals, such as the crocodile, water-snake, and the extinct Ichthyosaurus, are constructed upon this latter principle.

THE number of the *Trinidad Field-Naturalists' Club* for October 1895, contains an elaborate paper by Mr. T. I. Potter, on four species of *Oncidium*, natives of the island.

THE Field Columbian Museum has commenced the issue of a series of botanical papers, with a contribution to the Flora of Yucatan, by Mr. C. F. Millspaugh, botanical curator, illustrated by several photographs. The orders which are most numerously represented in the Peninsula are the Leguminosæ and the Compositæ.

ATTRACTIVE, but somewhat belated, are the Brochures 3 and 4 of vol ii. of the *Proceedings* of the Rochester Academy of Science, just received by us. The papers contained in these publications were, for the most part, read before the Society in 1893. Among the subjects treated are: "The Evolution of the Ungulate Mammals," by Prof. H. L. Fairchild; "Solar Electrical Energy not transmitted by Radiation" by Dr. M. A. Veeder; and "The Pitch Lake of Trinidad," by Mr. A. Cronise.

THE editor of *Just's Botanischer Jahresbericht* has issued an appeal to all botanists for a prompt despatch of separate copies of their contributions to scientific journals, or other botanical treatises. The average number of such papers, an abstract of which is given in each year's *Bericht*, is about 5300; and of these the editor has never received, up to the present time, copies of more than 300. The papers should be addressed to the Editor, Prof. Dr. E. Koehne, Kirchstrasse 5, Friedenau-Berlin.

VOL. iii. No. 6 of the Contributions from the *U.S. National Herbarium* consists of an interesting account of the botany of Yakutat Bay, Alaska, by F. V. Coville, to which is prefixed a general report on the characteristics of the Flora, by F. Funston. Even in August the danger in crossing the bay in canoes is very great from the floating ice. The country is largely covered by impenetrable forests of the Sitka spruce, *Picea sitchensis*. The number of species of vascular plants gathered was 137, the predominant orders being Ranunculaceæ, Rosaceæ, Compositæ, and Gramineæ.

Bulletin No. 9 of the "Minnesota Botanical Studies" for 1895 contains an interesting article, by Mr. R. W. Squires, on Tree-temperatures. The observations were made between

January and June on a specimen of *Acer Negundo*. During the whole of this period the temperature of the tree was lower than that of the air in the morning and at noon, but higher in the evening. The lowest temperature of the tree recorded was in February, – 21°·1 C. In the same part Miss H. G. Fox gives a monograph of the species of *Cypripedium* belonging to the Atlantic region of North America, six in number, with a scheme of the affinities of all the American species of the genus.

THE fourth volume of the *Transactions* of the Royal Society of Victoria (1895, pp. 166) is taken up with "A Monograph of the Tertiary Polyzoa of Victoria," by the late Dr. MacGillivray. The monograph is illustrated by twenty-two lithographed plates, all of which were prepared by Dr. MacGillivray, but only a few pages of the descriptive text had been written, and Prof. Baldwin Spencer and Mr. T. S. Hall are responsible for the descriptions required to complete it. In Victoria, as well as in South Australia, there are numerous Tertiary formations containing large deposits of Polyzoa, the accurate determination of which, especially in relation to the living species, is of great geological interest. Dr. MacGillivray's monograph, with its numerous fine illustrations of species, will prove of great assistance in working out this relation.

THE second volume on "Africa," in the new issue of Stanford's Compendium of Geography and Travel, deals with South Africa, and the author is Mr. A. H. Keane. The volume is not merely an enlarged edition of Keith Johnston's work, but practically a new publication, containing but a few passages of the original text, while only three of the old text-figures have been retained. Nnmerous new and carefully selected illustrations give attractiveness to the text, which is well abreast of the knowledge of African geography. How enormously the available information has increased may be gathered from the fact that the present volume, dealing with South Africa alone, runs into 671 pages; and we can quite believe Mr. Keane when he says: "Occurrences of far-reaching consequence have followed in such swift succession that in the preparation of this work the chief difficulty has been to keep pace with the shifting scenes." A broad view is taken of geography, attention being given to African history, political questions, and ethnology, as well as to the physical features, hydrography, and natural history of the continent. Altogether the volume is a valuable addition to the works dealing with Africa, and a desirable acquisition to every geographer's library.

THE first volume of what promises to be a very elaborate "Traité de Chirurgie clinique et opératoire," has come to us from MM. J. B. Baillière et Fils. The editors of the work, which will be completed in ten bulky volumes, are Profs. A. Le Dentu and P. Delbet; and if the first volume, dealing with general and special pathology, is followed by others of like fulness and quality, a valuable work of reference will have been added to the literature of surgery. The chief object of the editors—the object towards which the efforts of all physicians and surgeons tend—will be to make the publication the *livre de chevet* of those who are concerned with the origin and treatment of diseases. It is the surgery of to-day that will be expounded, not that of the past. The recent conquests in the domain of anatomy, bacteriology with all its applications to therapeutical surgery, and operative methods which have extended the field of action of surgery, will all be fully dealt with. Such a broad scope, when considered by the side of the distinguished men who have undertaken to write the various sections, is sufficient to establish the work in a high position.

IN a paper in the current number of the *Berichte* (January 13) by Lobry de Bruyn and A. van Ehenstein, further details are given of the properties of free hydrazine, NH_2—NH_2. In the first preliminary communication by M. Lobry de Bruyn, two methods of obtaining the anhydrous base were described, viz., by the action of barium oxide upon hydrazine hydrate, and by the reaction between sodium methylate and hydrazine hydrochloride in absolute methyl alcohol; in either case the hydrazine being separated by fractional distillation under reduced pressure. Free hydrazine is a liquid which at 23° has a density of 1·003, and on cooling with ice solidifies to a crystalline mass melting at 1°·4 C. Unlike free hydroxylamine, which is explosive, hydrazine is a very stable body, boiling unchanged under ordinary atmospheric pressure at 113°·5 C., and not decomposing at a temperature of 300°. In its chemical behaviour the free base resembles the hydrate, being oxidised to nitrogen by oxygen or air, and converting solid sulphur into hydrogen sulphide on warming. In a subsequent note in the same journal, by M. Lobry de Bruyn, an improved method is given for the preparation of hydrazine hydrate in quantity, advantage being taken of the fact that glass is not attacked by this substance at temperatures under 50° C. Since the hydrate boils at 47° under a pressure of 26 mm., the fractional distillation, if conducted at pressures below this, may be carried out in glass vessels.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*, ♂) from India, presented by Mr. Edmund Sheriff; a Common Boa (*Boa constrictor*) from Trinidad, presented by Mr. S. A. Cumberland; a —— Antelope (*Cervicapra*) from Africa, a Kinkajou (*Cercoleptes caudivolvulus*) from South America, a Cormorant (*Phalacrocorax carbo*), British, two Samoan Fruit Pigeons (*Ptilonopus apicalis*) from Samoa, deposited; a Sharp-nosed Snake (*Passerita mycterizans*) from India, purchased.

OUR ASTRONOMICAL COLUMN.

ECLIPSES IN FEBRUARY.—During the present month there will be an annular eclipse of the sun and a partial eclipse of the moon. The former will occur on February 13, but as the path of the annulus lies wholly in the South Atlantic and Antarctic Oceans, it is of little interest. At the Cape of Good Hope it will be visible as a partial eclipse, magnitude 0·849, the greatest phase occurring at 6h. 38m. Cape mean time, that is, sixteen minutes before sunset.

The more important phases of the partial eclipse of the moon on February 28 will be visible in this country, provided the weather be favourable. The following particulars for Greenwich are from the *Companion to the Observatory*:—

	h. m.		h. m.
First contact with penumbra	5 15·5	... With shadow	6 16·3
Last ,, ,,	10 15·9	... ,, ,,	9 15·1

First contact with shadow takes place at an angle of 85° from the north point towards the east, and the last contact at 30° towards the west. The magnitude of the eclipse (moon's diameter = 1) will be 0·870. The moon will rise at 5h. 27m.

During the partial eclipse the following stars will be occulted:

Star.	Mag.	Disappearance or Reappearance.	G.M.T.	Angle E. of N.
			h. m.	
B.D. +7°2373	9·3	D	6 42	81
+6°2364	8·8	D	7 6	147
+7°2370	9·5	R	7 7	325
+7°2373	9·3	R	7 28	334
+7°2364	8·8	R	7 56	270

ASTROPHYSICAL STANDARDS.—The need for greater uniformity in standards, &c., has long been felt by all engaged in astrophysical researches, and we learn with pleasure that the Editorial Board of the *Astrophysical Journal* has taken up the matter. As the result of a circular addressed to the Associate Editors, the following decisions have been arrived at, and an

appeal is made for their general adoption. Rowland's scale of wave-lengths, as represented by the tables in course of publication in the journal above named, is to be employed, and the unit of wave-length is to be the ten-millionth of a millimetre, or "tenth-metre." For measurements of velocity in the line of sight, the kilometre is to be taken as the unit. To distinguish the lines of hydrogen, the nomenclature starting with H_α in the red and continuing in alphabetical order through the entire series is agreed upon. Maps of spectra are to be drawn with the red end to the right, and tables of wave-length are to be printed with the shorter wave-lengths at the top.

Although some of the leading workers in astrophysics have not been consulted, it is probable that these arrangements, so far as they go, will meet with general approbation. It is to be regretted, however, that the representation of intensities of spectrum lines was not considered, as a scale which every one might be willing to adopt is, perhaps, even more urgently required than any general agreement on the points to which reference is made above.

REPRODUCTION OF ASTRONOMICAL PHOTOGRAPHS.—The Council of the Royal Astronomical Society has lately undertaken the reproduction (by paper prints and lantern slides) of a selection of the instructive astronomical photographs in the possession of the Society. The prints and lantern slides are sold to Fellows of the Society at approximately cost price, and full details as regard subject, instrumental data, exposure, &c., are given upon each. Among the celestial pictures which have been thus rendered available to a wider circle of astronomers, are

photographs of total solar eclipses of 1886, 1889, and 1893, Dr. Roberts' photographs of the Pleiades and the Great Nebula in Orion, Prof. Barnard's photographs of the Milky Way, and of Brooks' and Swift's comets, Dr. Gill's photograph of the nebula about η Argûs, and MM. Loewy and Puiseux's lunar photographs. The accompanying illustration of the eclipse of April 16, 1893, has been reduced by one-third from a print sold by the Society. The original was taken by Sergt.-Major Kearney, R.E., at Fiundium, West Africa, with a Dallmeyer photoheliograph, the exposure being twenty seconds.

HOLMES' COMET.—Prof. Barnard has just published an account of his observations and photographs of this comet, made during its appearance in 1892 and 1893 (*Astrophysical Journal*, vol. iii. No. 1). Some of the telescopic features appear to have been quite unique. On January 4, 1893, only a feeble glow was visible; twelve days later it seemed like a hazy star, and the nucleus was actually seen to brighten in the few hours of observation, while the body itself expanded; six days afterwards, the nucleus had almost disappeared again. A photograph taken on November 10, 1892, is chiefly remarkable as showing a large irregular mass of nebulosity covering an area of at least a square degree, and connected with the comet by a short hazy tail. This curious appendage, which certainly belonged to the comet, seems to have been overlooked by most observers, but its recognition may possibly at some time or other prove to be of importance. The facts seem to be in favour of the comet having suddenly become bright just before the time of its discovery. It differed from the average comet in having a nearly circular orbit, and unless there had been some great change in its path, or some internal change, it should have been discovered long before. As the comet could not be seen with the Lick telescope during the succeeding opposition, Prof. Barnard thinks that it no longer exists in the cometary form, and will never be seen again.

THE LIQUEFACTION OF AIR AND RESEARCH AT LOW TEMPERATURES.[1]

THE best and most economical plant for the production of liquid air or oxygen is one based on the general principle of that used by Pictet in 1878, for liquefying oxygen; instead, however, of using Pictet's combined circuits of liquid sulphur dioxide and carbon dioxide kept in circulation by compression, liquefaction and exhaustion, it is better to employ ethylene in one circuit, as Cailletet and Wroblewski did, and to use nitrous oxide, or preferably carbon dioxide, in another. Further, instead of causing the oxygen to compress itself during its formation from potassium chlorate heated in an iron bomb connected with the refrigerator, it is found convenient to use gas previously compressed in steel cylinders.

A very convenient laboratory apparatus, the arrangements of the circuits of which will be easily understood from the sectional view shown in Fig. 1, has been devised for the liquefaction of small quantities of oxygen or other gases; with this simple arrangement, 100 c.c. of liquid oxygen can readily be obtained, using liquid carbon dioxide at $-79°$ C. for cooling and employing no exhaustion. The gaseous oxygen, cooled before expansion by passing through a spiral of copper tube immersed in solid carbon dioxide, passes through a fine screw stopcock under a pressure of 100 atmos., and thence backwards over the coils of pipe. The liquid oxygen begins to drop in about a quarter of an hour from starting. The pressure in the oxygen cylinders at starting is generally about 150 atmos., and the best results are got by working down to about 100. This little apparatus will enable liquid oxygen to be used for demonstration and research in all laboratories.

By employing jacketed glass vessels, of which the annular space is highly exhausted, for storing liquefied gases, the influx of heat is reduced to one-fifth of that which occurs when the jacket contains air; if the interior walls are silvered, or excess of mercury vapour is left in the jacket, the influx of heat is again reduced to one-sixth, so that the total effect of the high vacuum and the silvering is to reduce the ingoing heat to about 3½ per cent. of that which enters when these precautions are neglected. The suggestion that the metallic coating is useless, because Pictet has found that all kinds of matter are transparent to heat at low temperatures, is thus disposed of; further, no increase in the transparency of glass to thermal radiation occurs on cooling to the boiling point of air.

In order to test Olszewski's statement that air cannot be solidified at the lowest pressures (*Phil. Mag.*, February 1895), the author's former experiments have been repeated on a larger scale. If a litre of liquid air be exhausted in a silvered vacuum vessel, half a litre of solid air may be obtained and kept solid for half an hour. The solid is at first a stiff transparent jelly, which, when placed in a magnetic field, has the still liquid oxygen drawn out to the poles, showing that solid air is a nitrogen-jelly containing liquid oxygen. Solid air can only be examined in a vacuum or an atmosphere of hydrogen, because it instantly melts on exposure to the air, causing an additional quantity of air to liquefy; it is strange to see a mass of solid air melting in contact with the atmosphere, and all the time welling up like a fountain.

On causing dry air, contained in sealed flasks, to solidify by

[1] A paper read before the Chemical Society on December 19, 1895, by Prof. J. Dewar, F.R.S. (Abridged from the *Proceedings* of the Society issued January 14.)

immersing the side arms attached to the flasks in liquid air boiling under a low pressure, and subsequently hermetically sealing off the side arms containing the solid, the residual air left in the flasks may be preserved for analysis; it is then ascertained that the residual air still contains oxygen and nitrogen in the usual proportion. In the earlier experiments, the argon solidified before the nitrogen, but chemical nitrogen and air nitrogen with

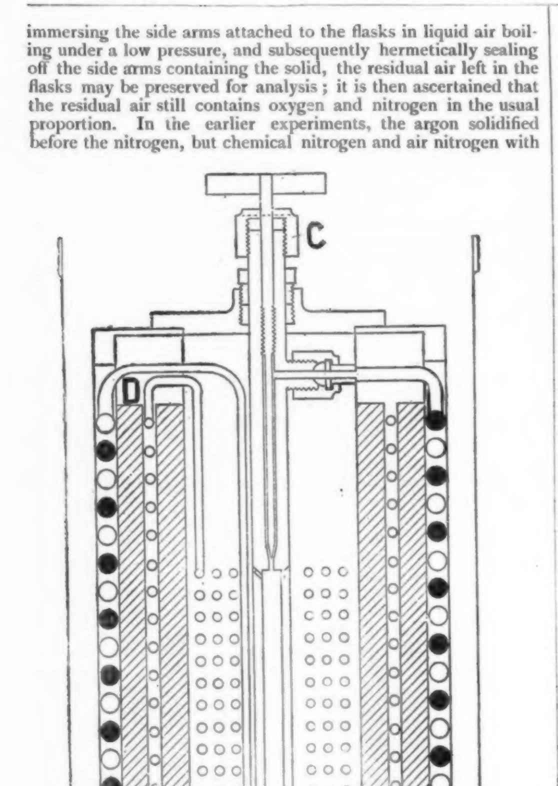


FIG. 1.—A, air or oxygen inlet. B, carbon dioxide valve. D, regenerator coils. F, air or oxygen expansion valve. G, vacuum vessel with liquid oxygen. H, carbon dioxide and air outlet. ○, air coil. ● carbon dioxide coil.

its 1·1 per cent. of argon behaved in substantially the same way on liquefaction.

Olszewski has examined liquid nitric oxide, and describes it as colourless, but on strongly cooling several carefully purified samples of this gas, which had been prepared by different methods, the author obtained in each case a nearly white solid melting to a blue liquid. The colour is more marked at the melting than at the boiling point, and the liquid is not magnetic. Solid nitric oxide is not phosphorescent, nor does it show any chemical action in liquid oxygen, provided the tube containing it is completely immersed; but if the tube full of liquid oxygen be lifted into the air, a violent explosion almost instantly occurs.

In a good vacuum vessel, specific gravities may be taken in liquid oxygen as easily as in water. Some twenty substances were weighed in liquid oxygen, and the apparent density of the liquid calculated; the results were then corrected, using Fizeau's values for the variation of the coefficients of expansion of the solids employed, and the real density of liquid oxygen was thus calculated as 1·1375 under a pressure of 766·5 m.m. The variation of density is about ± 0·0012 for 20 m.m. pressure. Wroblewski found the density of liquid oxygen at the boiling point to be 1·168, whilst Olszewski found 1·124. Fizeau's parabolic law for the variation of the coefficient of expansion holds down to $-183°$; the solid which contracted least during cooling was a compressed cylinder of silver iodide, that which contracted most a block of compressed iodine.

Similarly the density of liquid air was found to be 0·910 and that of nitrogen at its boiling point 0·850. No great accuracy attaches to the density of liquid air as thus determined, for liquid air kept in a silvered vacuum vessel rises 1° in boiling point every ten minutes during the first hour; the density of

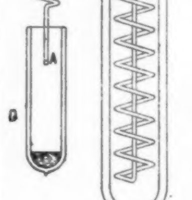


FIG. 2.

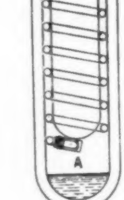


FIG. 3.

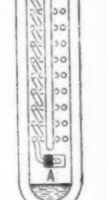


FIG. 4.

liquid air, however, does not reach that of pure oxygen even after thirty hours' storage.

A small ignited jet of hydrogen burns continuously below the surface of liquid oxygen, all the water produced being carried away as snow. There is a considerable amount of ozone formed, which concentrates as the liquid oxygen evaporates. In the same way graphite, or diamond, when properly ignited, burns continuously on the surface of liquid oxygen, producing solid carbonic acid and generating ozone. If liquid oxygen is absorbed in wood charcoal, or cotton wool, and a part of the body heated to redness, combustion can start with explosive violence.

The experiments of Joule and Thomson and Regnault on the temperature of gas jets issuing under low pressures are well known; the following observations refer to the pressure required to produce a lowering of temperature sufficient to yield liquid in the gas jet. The apparatus used in the study of highly compressed gas jets is sketched in Fig. 2; C is a vacuum tube holding a coil of pipe about 5 mm. in diameter along with carbon dioxide or liquid air for cooling the gas before expansion, and A is a small hole in the silver or copper tube about $\frac{1}{2}$ mm. in diameter, which takes the place of a stopcock. When carbon dioxide gas, at a pressure of 30 or 40 atmos., is expanded through such an aperture, liquid can be seen where the jet impinges on the wall of the vacuum tube along with a considerable amount of solid. If oxygen gas escapes from the small hole at the pressure of 100 atmos., having been cooled previously to $-79°$ in the vessel C, a liquid jet is just visible. It is interesting to note in passing that Pictet could get no liquid oxygen just below 270 atmos., owing to his stopcock being massive and outside the re-

frigerator. If the oxygen is replaced by air, no liquid jet can be seen unless the pressure is raised to 180 atmos. If the carbon dioxide is cooled by exhaustion (to about 1 in. pressure) or $-115°$, liquid air can easily be collected in the small vacuum vessel D, or if the air pressure is raised above 200 atmos., keeping the cooling at $-79°$ as before. The chief difficulty is in collecting the liquid, owing to the rapid current of gas. The amount of liquid in the gas jet is small, and its collection is greatly facilitated by directing the spray on to a part of the metallic tube above the little hole, or by increasing resistance to the escaping gas by placing some few turns of the tube, like B in the figure, in the upper part of the vacuum tube, or generally by pushing in more tube in any form. For better isolation, the pipe can be rolled between two vacuum tubes, the outer one being about nine inches long and one and a half inches diameter, as shown in Fig. 3; the aperture in the metal pipe has a small piece of glass tube over it, to help the collection of the liquid. Using this apparatus and an air supply at 200 atmos. with no previous cooling, liquid air begins to collect in about five minutes, but the liquid jet can be seen in two to three minutes. In Fig. 4 the metallic tube in the vacuum vessel is placed in horizontal rings, leaving a central tube for the passage of the glass tube C, which is used to cool bodies or examine gases under compression; the inner tube can be filled for an inch with liquid air at 60 atmos. pressure, in about three minutes. A double coil of pipe may be advantageously used in some experiments; the efficiency is low, but it affords a quick method of reaching low temperatures and collecting a few hundred cubic centimetres of liquid air. By the use of this apparatus air at the ordinary temperature can be simply converted into liquid air at the boiling point, $-194°$, in less than ten minutes; a fall of 200° is effected in this short period of time.

The author, after giving a sketch of the results up to the present achieved in connection with the liquefaction of hydrogen, remarks that hydrogen, cooled to $-194°$ (80° abs. *t*), the boiling point of air, is still at a temperature which is two and a half times its critical temperature, and its direct liquefaction at this point would be comparable to that of air taken at 60°, and liquefied by the apparatus just described. Now, air supplied at such a high temperature greatly increases the difficulty and the time required for liquefaction. Still, it can be done, even with the air supply at 100°, in the course of seven minutes; and this is the best proof that hydrogen, if placed under really analogous conditions, at $-194°$ must also liquefy with the same form of apparatus. Hydrogen, cooled to $-200°$, was forced through a fine nozzle under 140 atmos. pressure, and yet no liquid jet could be seen. If the hydrogen contained a few per cent. of oxygen the gas jet was visible, and the liquid collected, which was chiefly oxygen, contained hydrogen in solution, the gas given off for some time being explosive.

If, however, hydrogen, previously cooled by a bath of boiling air, is allowed to expand at 200 atmos. over a regenerative coil similar to that shown in Fig. 2, but longer, a liquid jet can be seen after the circulation has continued for a few minutes along with a liquid which is in rapid rotation in the lower part of the vacuum vessel. The liquid did not accumulate, owing to its low specific gravity and the rapid current of gas. These difficulties will doubtless be overcome by the use of a differently shaped vacuum vessel and by better isolation. The liquid jet can, however, be used as a cooling agent, like the spray of liquid air obtained under similar circumstances, and, this being practicable, the only difficulty is one of expense. In order to test in the first instance what the hydrogen jet could do in the production of lower temperatures, liquid air and oxygen were placed in the lower part of the vacuum tube just covering the jet. The result was that in a few minutes about 50 c.c. of the respective liquids were transformed into hard white solids resembling avalanche snow, quite different in appearance from the jelly-like mass of solid air got by the use of the air pump. The solid oxygen had a pale, bluish colour, showing by reflection all the absorption bands of the liquid. There is no reason, apart from that of cost, why a spray of liquid hydrogen, at its boiling point in an open vacuum vessel, should not be used as a cooling agent in order to study the properties of matter at some 20° or 30° above the absolute zero.

The only widely distributed element which has not yet been liquefied is fluorine; and it would seem that, although the atomic weight of fluorine is nineteen times that of hydrogen, it must in the free state approach hydrogen in volatility. If the chemical energy of fluorine is abolished at low temperatures, like that of other active substances, some kind of glass or transparent substance, less brittle than calcium fluoride, could be employed in the form of a tube, and the liquefaction of fluorine achieved by the use of hydrogen as a cooling agent.

SCIENCE IN THE MAGAZINES.

POLITICS saturates the February magazines, but science is not altogether drowned in this plethora of diplomatic diatribes. There are four articles in the *Contemporary* of interest to scientific readers. Mr. Herbert Spencer traces the development of the sculptor, and shows how, in its primitive character, sculpture was an auxiliary to ancestor-worship. "The tomb and the temple are," he shows, "developed out of the shelter for the grave—rude and transitory at first, but eventually becoming refined and permanent; while the statue, which is the nucleus of the temple, is an elaborated and finished form of the original effigy placed on the grave. The implication is that, as with the temple so with the statue, the priest, when not himself the executant, as he is among savages, remains always the director of the executant—the man whose injunctions the sculptor carries out." Mr. W. H. Hudson writes pleasantly, if somewhat aimlessly, about the village of Selborne and of the simple naturalist whose observations have made it famous. Mr. W. H. Mallock continues his study of "Physics and Sociology." The argument of the two articles which preceded the present one may be thus summarised: Great men are analogous to atoms of superior size, on whose presence the aggregation of all the other atoms depend, therefore they should form the first study of the sociologist. Two propositions (among others) which follow from this conclusion are now stated by Mr. Mallock; the first of them being more or less of a heresy, so far as scientific opinion is concerned. The propositions are as follows. (1) Other things being equal, communities progress and become civilised not in proportion to the talents of the mass of the individuals who compose them, but in proportion to the percentage which occurs in each of the individuals whose talents are superior to those of the mass. (2) Other things being equal, communities progress and become civilised in proportion to the desirability of the rewards which are practically attainable in each by the exercise of superior talents, and which thus stimulate the possessors of these talents to develop them, and make them actual instead of merely potential. Mr. D. C. Boulger having suffered from diphtheria, and been made a victim of the anti-toxin treatment, survived, and now records his experience of the disagreeable character of the disease and its sequelæ, all of which unpleasantness was aggravated, in his opinion, by the employment of antitoxic serum. From his particular case, he passes to a general discussion of diphtheria and antitoxin, which he condemns. So few are the gifts to science and education in England, that we rejoice to find Mr. Bernard Shaw commending in the *Contemporary* such benefactions to the attention of millionaires. The questions which a millionaire, moved by a generous spirit to benefit any locality, should ask himself are: "Has it a school, with scholarships for the endowment of research, and the attraction of rising talent at the universities? Has it a library, or a museum? If not, then he has an opening at once for his ten thousand or hundred thousand pounds."

"Reflex Action, Instinct, and Reason" are discussed from the point of view of their development in the *Fortnightly* by Mr. G. A. Reid. It suffices here to call attention to the article, which is a chapter from a forthcoming book on "The Present Evolution of Man," and to state the definitions of instinct and reason given in it. Instinct is defined as "the faculty which is concerned in the conscious adaptation of means to ends," by virtue of inborn inherited knowledge and ways of thinking and acting. Reason is defined as "the faculty which is concerned in the conscious adaptation of means to ends" by virtue of acquired non-inherited knowledge and ways of thinking and acting. An admirable article on "Plant Names" appears in the *Quarterly Review* (January), being a review of the "Index Kewensis" and of four other recent publications upon the names of plants. In the *National*, Mr. Walter B. Harris describes Tiflis, the capital of Transcaucasia, and in *Scribner* an interesting account is given of an ascent of Mount Ararat, the paper being illustrated by several of the finest specimens of process-work we have ever seen.

Knowledge contains articles on curious facts in plant distribution, by Mr. W. B. Hemsley, F.R.S.; waves, by Mr. Vaughan Cornish; Antarctic exploration, by Mr. W. S. Bruce; and comets of short period, by Mr. W. E. Plummer. There is also a full-page reproduction of Dr. Roberts' photograph of the nebula near 15 Monocerotis. We omitted to mention that in the January number, Dr. H. R. Mill had an article on "Geography as a Science in England," in which he pleaded for a more scientific study of geography.

Longman's Magazine has an excellent short article on the Pasteur Institute, by Mrs. Frankland. Mr. H. M. Stanley tells "The Story of the Development of Africa" in the *Century*. Among the subjects lightly and brightly treated in *Chambers's Journal* are left-handedness, by Dr. R. A. Lundie; turpentine farms in Georgia; Bath brick; new work on the filtration of water; and flint-knapping. Dr. Andrew Wilson writes on Medusæ in the *English Illustrated*. A description of the fantastic forms taken by lycopodium powder or a semi-liquid substance, when placed upon a flexible membrane set vibrating by the voice, is given by Margaret W. Hughes in *Good Words*, under the title of "Voice Figures." The article is illustrated by reproductions of some of the beautiful patterns thus produced. An article entitled "The Romance of the Museums," in the *Strand Magazine*, contains a short description, with illustration, of the Cranborne meteorite, in the British Museum Collection. The same magazine has in it a short story of adventure, founded upon the action of the "Souffleur" at Port Gorey, Sark. The scientific interest of the story lies in the section which is given of the Gouliot Caves, in order to explain how "Souffleurs" are caused.

THE CONSTITUTION OF SCIENTIFIC SOCIETIES.[1]

SOME cultivators of the sciences occasionally complain that the meetings of scientific bodies are not well attended, and that they read papers to too many empty benches. Moreover, even when they have a scientific audience they allege that very few of those present understand what they have to say. And they speculate on measures to be adopted to remedy this state of affairs.

As the scientific investigator acquires years and experience, he recognises that in the present state of human society he has no right to expect that the situation can be very different. The number of serious cultivators of science in any community is not large, and the number of men engaged in original research in any given field is still smaller. Like the landed aristocracy of the old nations, the producers in each department of science are well scattered over a country, and it is only on national occasions that they gather in any considerable force. The situation as to the audiences who assemble to listen to papers of original value in pure science is therefore not likely to change for some years. In fact, the size of audiences may be set down as inversely as the rationality, and directly as the emotionality of the matter set before them. Such is the present state of the civilised nations of the earth, and it is not peculiar to any one of them.

Most of the large cities of the United States have an "Academy of Sciences," or its equivalent, and it is largely with reference to the prosperity of those bodies that discussions such as we have referred to above is heard. Many of the members want them to be what they call popular, which, in its best sense, means that they wish for large audiences at the meetings. Now, if what we have said above is true, this object cannot be attained unless the academy abandons its real object, the advancement of scientific knowledge by original research. This is the primary object of academies of science in all countries, and if they neglect it, they lose their identity, since the facilities for the distribution of knowledge are everywhere relatively abundant. When the academy of science becomes a distributor of knowledge only, it abandons its important proper function, and becomes comparatively a nonentity. Let us hope that academies of science in America will not follow the course of the academies of music, which are, in Europe, educational and critical, in America, mere theatres.

The measures adopted by academies of science in the United States to make themselves popular and therefore "successful," are often highly amusing. The usual method is to elect some man president who is rich but unknown to science; since, in the minds of some people, money is the source of the sciences and the arts. Men of the same type are also often elected to other responsible positions in these societies for similar reasons. We have watched this mode of attacking the problem for many years, and have never known it to be successful. In the case of the Philadelphia Academy, it did, on one occasion, entail a loss of over $12,000 cash capital to the Society. In fact, the reasons why this method should not prove successful are not far to seek. The only way to make it successful would be to have a bill of sale of the office legally executed, so that the sum agreed on could be collected by process of law in case of failure to produce the "consideration" after the election. This the business world understands, whereas it does not perceive the cash value of original research. In fact, the election of an outsider to rule over them by a body of experts for a supposed financial equivalent, is a proceeding not calculated to excite the respect of a rich man or any other kind of man.

A society is, however, fortunate if it escapes without more serious injury than a financial disappointment. Men not habituated to the ways and means of research frequently apply nostrums which do more harm than good, and bring the society into deserved contempt. Thus in one city the president, who was of the type mentioned, succeeded in incorporating into the society a body of photographers, with the result of simply developing the photographic society. The men by whom the original society was known to the world were locally quite lost sight of. In another city a number of local amateur astronomical clubs were taken into the academy. These consisted of ladies and gentlemen whose devotion to science consisted in viewing the stars in each others pleasant society. Another academy adopted popular lectures as a device for filling empty benches. The selection of the lectures being in the hands of incompetent officers, cranky and ignorant persons, and those who had apparatus to sell, occupied the time of the academy, to the great scandal of the really scientific men of the city.

The appointment of amateurs and unscientific persons to positions in scientific bodies, often has ludicrous results. One academy of science discussed an ancient bone dredged up in salt water. It was perforated with fossæ in series, and it was concluded that it was a mouth bone of a fossil fish. It turned out to be the head of an ancient tooth-brush. An exhibition of foot-tracks on ancient rocks before the same academy, brought to his feet a dancing-master, who illustrated the formation of the impressions terpsichorean fashion.

Another plan for promoting the prosperity of scientific bodies is to have dinners and social receptions. These methods are always successful in drawing together numbers, and if persons are to be elected members of such societies in proportion to their gastronomic capacities, such a system must be eminently successful. To be serious, however, and to repeat what should be self-evident to every person, this plan tends only to an increase o. non-expert membership, which is really at the bottom of all the evils which have befallen scientific societies. Hence, unless some measures to protect the membership be adopted, this method of "promotion" should be always rejected.

The result, both of our observations and cogitations on this subject, is that the only method by which academies of science can advance themselves in the public esteem, is to continue in their work of original research. If they cannot acquire public confidence in this way, they cannot acquire it at all. There is no short-cut to this so-called "success." As in all other human endeavours to wrest advantage from nature, labour and labour only "omnia vincit." As with the agriculturist, the machinist, or the accumulator of money, devotion to work, and this only, brings the rewards which we seek. The visible products of labour are what men respect, and if the scientific man wishes to inspire the respect of wealth, he must show results, rather than bestow on men of wealth what are to them empty honours.

[1] Reprinted from the *American Naturalist*, December 1895.

SCHOLARSHIP SCHEMES OF TECHNICAL EDUCATION COMMITTEES.

ONE of the chief ways in which Technical Education Committees all over the country spend the funds entrusted to them is in the award of scholarships; and if this branch of their work is wisely organised and carried out, there is no better method of securing the proper education of promising boys and girls. The scholarships awarded can be divided into four classes, namely, those tenable at (1) Technical Schools and Science and Art Schools; (2) Secondary Schools; (3) Universities or institutions of University rank; (4) short courses of instruction. Full information

with reference to these scholarships has appeared at various times in the *Record* of Technical and Secondary Education. An examination of the particulars there given reveals several interesting facts, not the least among which is the diversity of opinion as to what the candidates for such exhibitions and scholarships should be examined in. At Plymouth, boys are expected only to have a knowledge of sixth and seventh standard work when they enter for scholarships of the first of the above divisions, while those of Bristol are set papers not only in elementary subjects, but also in algebra, Euclid, French, German, chemistry, botany, &c. Candidates in Blackburn and Stockport, amongst numerous other places, are set papers in the subjects of the "Science and Art Directory," though in the former place any commercial knowledge proves useful, and at Stockport boys may enter themselves for any branch of technology mentioned in the City and Guilds' programme. Such facts as these show that we are yet far removed from any definite and uniform course of education graduating from the elementary school upwards. The complaints, which are published in most of the County Council reports, of the hopelessness of looking for any satisfactory progress in technical instruction until the students entering technical or science and art schools are better prepared to benefit by their teaching, are likely to be often repeated unless it is made compulsory upon all scholarship holders to give satisfactory evidence of their acquaintance with, at least, the work of the elementary schools. In some cases, authorities have tried to avoid this difficulty by stipulating that candidates shall have been pupils in elementary schools; but it is notorious that a year or two after leaving school most boys have completely lost any knowledge they may have had. Means by which the continuity of a boy's education may be ensured have yet to be taken. No permanent gain can result if technical work is built on insecure foundations, and we imagine that the foundations of scientific knowledge can be very properly begun in the elementary school. This knowledge should be carried on in evening continuation schools, and attendance at such schools should be made compulsory, as it is in Germany. If that were done, a boy at the age of seventeen would be in fit condition to enter the true technical school, whereas, under the present system of elementary education, he is not. The want of agreement to which we have referred obtains also when we come to consider the conditions under which scholarships to secondary schools are awarded. The most striking feature here is perhaps the countenance which is given to dabbling in all sorts of subjects. Since the secondary school is, as a rule, intended for boys from about thirteen to sixteen or seventeen years, and is, or should be, entered at, or about, the lower age, it seems unreasonable to expect any candidate to have done anything of importance at such subjects as botany and physiology, and yet such subjects are continually asked for. At every point one is struck with the want of coordination in the various grades of English education. If we could once get something like a consensus of opinion as to the proper work of the elementary, the secondary, the technical school, and finally of the college, this continual difficulty of what to examine in would not arise. When we come to look into the regulations affecting the scholarships offered by the technical instruction committees at universities or institutions of university rank, it becomes painfully evident that such committees are by no means clear what their work properly is. Several county authorities consider a knowledge of Latin, and one at least recognises familiarity with Greek, as being desirable for technical students. It is not our desire to decry the study of the classics, but we maintain that neither Greek nor Latin gives any claim to a technical scholarship, and, further, that the grant for technical education is being wrongly used if it is awarded for proficiency in such subjects. It cannot be too much insisted upon that one of the points which the advisers and directors of the various committees need yet to consider, refers to the requirements and capacities of the different classes of the community, and how these can best be met.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The lecture list for the current Term contains a few features of interest. In the Department of Medicine Dr. J. Ritchie gives a practical course of Elementary Morbid Histology, making use for the first time of the pathological laboratory which has recently been fitted up in the Department of the Regius Professor of Medicine.

Mr. J. C. Alsop is assisting the Professor of Experimental Philosophy in practical instruction, and Mr. E. W. A. Walker is assisting in the practical course of Physiology in the Department of Physiology. Otherwise the courses of lectures in the Faculties of Medicine and of Natural Science are unchanged.

An examination for a Radcliffe Travelling Fellowship will be held during the present term, commencing on March 3. Intending candidates, who must declare that they intend to devote themselves to the study of Medical Science during the tenure of the Fellowship, and travel abroad with a view to that study, are required to send their names and qualifications to the Radcliffe Examiners, the Radcliffe Library, Oxford, on or before February 3.

Mr. W. Warde Fowler, Fellow of Lincoln College, has been appointed a Curator of the Botanic Garden, in place of Mr. Edward Chapman, Fellow of Magdalen College, resigned.

The Delegacy of Non-Collegiate Students announce that a Shute Scholarship of an annual value of £50 will be awarded on Saturday, June 20. The examination will be in Chemistry, and will commence on Tuesday, June 2. The Scholarship is open, and there is no limitation of age; but no member of the University will be eligible, who shall have completed eight Terms from the date of matriculation.

CAMBRIDGE.—The Council of the Senate have appointed Mr. Charles Smith, Master of Sidney Sussex College, Vice-Chancellor, a Governor of Eton College, in the room of Dr. Forsyth, F.R.S., who has resigned.

The subscribers to the Robertson Smith Memorial have paid over to the University £335 for the purchase of Oriental manuscripts, after investing some £1100 for the maintenance in Christ's College of the late Professor's library.

The memorial respecting degrees for women, signed by over 2000 members of the Senate, has been presented to the Council. The discussion of the subject by means of fly-sheets and pamphlets has already begun, and promises to be unusually keen.

At the matriculation on January 28, twenty-seven new names were added to the list of freshmen; this raises the total entry up to the present to 938.

ON Friday, January 31, the Duke of Devonshire distributed certificates to the scholars and exhibitioners elected last year by the Technical Education Board of the London County Council. There were 5 senior county scholars, 60 intermediate county scholars, 600 junior county scholars, 135 art scholars and exhibitioners, and 73 evening science exhibitioners, making a total of 882. What the scholarship scheme of the Board is, and what it aims at doing, will be gathered from the following remarks made by the Duke of Devonshire. In the first place there are the junior county scholarships, open to boys and girls under thirteen years of age, by competition. These scholarships carry with them free education in a secondary selected school for two years, and a money payment divided between the two years of £20. The examination by which they are gained is an examination in the subjects taught in elementary schools. Thus, the advantage of two years of education beyond the age of thirteen in a higher school is opened up to a large number without any cost to themselves or to their parents. It is the first step upon the educational ladder which has been set up by the County Council, and whether that step is taken as a preliminary to an attempt to rise to higher rungs of that ladder, or whether it is taken with no object of prosecuting the ascent higher, yet the advantage of these two added years of education in an efficient selected school may prove and ought to prove of immense value to the student. The next step in this ladder is a grant of a smaller number of intermediate county scholarships, which enable boys and girls under the age of sixteen to continue their education further in secondary schools up to nineteen, and of course carrying with them a higher money payment to compensate for the higher value of the labour which it is the object of this scheme to make during the period of education necessary; and, finally, the County Council offer a limited number of still higher scholarships which will enable the fittest of those who have distinguished themselves in previous competitions to continue their education for three years in either a college or some other institution of University rank. What, in fact, the County Council, through its Technical Board, has been able to do has been to establish something in the nature of a technical

University for the county of London, although the County Council itself has not assumed any such ambitious denomination for its work. On the contrary, continued the Duke, the Technical Education Board is fully aware of the need of our great metropolis for a teaching University, and it has promised to that new University a contribution of £10,000 a year, contingent upon the organisation of that body being such as will secure the advantages of a new University to all classes of the inhabitants of London, including the artisan and the labouring classes. The Council has thus shown the most practical proof that in its opinion the great work which it has already undertaken still requires to be supplemented by something more thoroughly and more completely deserving the name of University education for the county of London.

WE learn from the *Times* that Mr. T. H. Ismay has written to the President of the Liverpool Engineering Society, offering on behalf of the White Star Line Company the sum of £2000, to be used in founding and maintaining in connection with University College a scholarship intended to perpetuate the memory of the late Sir Edward Harland and his association with the shipping life and engineering profession of Liverpool. It is proposed that the scholarship shall be awarded for nautical engineering and marine architecture, and called the "Sir Edward Harland Memorial Scholarship."

THE following new announcements of gifts to educational institutions in America are noted in *Science*. Mr. J. H. Armstrong, of Plattsburg, deeded a considerable property to Union College, but retained a life interest in it. On January 2 of this year he died, and by his will added to the gift, which now amounts to 100,000 dols. The Legislature of Massachusetts has passed the Bill granting 25,000 dols. to the Massachusetts Institute of Technology. Mrs. Josiah N. Fiske has given Barnard College 5000 dols. for the foundation of a scholarship which will be open to competition.

SCIENTIFIC SERIALS.

THE *Quarterly Journal of Microscopical Science* for January 1896, contains but one article—on the development of *Asterina gibbosa*, by E. W. MacBride, Fellow of St. John's College, with plates 18-29. The investigations forming the subject of this memoir were commenced some years ago; the author at first intended to work out the development of the so-called heart, with its accompanying sinuses, in the Asterids, as he had previously done in the case of the Ophiurids. Coming to the conclusion, however, that our knowledge of the development of most of the organs in the Asterid body was very defective, he determined to thoroughly revise their whole history, embryonic and larval. This work has occupied his attention for the last two years, and as a result we have this carefully written memoir, which the author hopes may be found to place our knowledge of Asterid development on the same level as that to which our acquaintance with Crinoid ontogeny has been raised by the researches, among others, of Bury and Seeliger. The material was chiefly collected at the Naples Station. The memoir is prefixed by a statement of the methods of research adopted, and concludes with a chapter entitled "General Considerations," in which two questions are asked: (1) What light does this history throw on the affinities of the Asterids with the other Echinoderms? and (2) Does it suggest any direction in which we may look to find the origin of the group Echinodermata? The answer given to the former is that the Asterids have an affinity with the Crinoids, and that they had a fixed ancestor; and to the latter, that assuming a free-swimming ancestor of Echinoderms (provisionally called Dipleurula), it and the Tornaria ancestor of Balanoglossus must have been closely allied. This further involves the assumption that the Asterids were thus allied to the Protochordata.

THE number of the *Nuovo Giornale Botanico Italiano* for January contains, among others, the following papers:—Botanical results of a journey to the Lower Obi, by S. Sommier.—A paper by A. Pizzigoni on the dry and moist cancer of the potato, which he regards as two distinct diseases; the former due to the attacks of *Fusisporium solani* alone, the latter to this fungus, together with bacteria.—Sig. G. Del Guercio describes the changes produced in the cortex of the oak by the attacks of the larva of *Gracilaria simploniella*.—Prof. A. Borzì has a paper on the hydrophorous apparatus of xerophilous plants belonging to the Mediterranean flora; those specially described are the nodal sheath and cushion of many Caryophyllaceæ, the leaf-sheath of Gramineæ and Umbelliferæ, and the ochrea of Polygonaceæ.—Sig. A. Lenticchia contributes a useful list of the flowering plants of Italian Switzerland.

IN the *Bullettino* of the Italian Botanical Society for December 1895 and January 1896, are papers on the dimorphism in the flowers of *Convolvulus arvensis*, caused by the attacks of *Thecaphora hyalina*.—On the meteorology of the year 1895, and its effects on the plants in the Botanic Garden at Florence. The lowest temperature recorded during the severe winter 1894-95 was -7° C.—On the biology of the flowers of *Oxalis cernua*, with especial reference to the occurrence of fertile flowers intermediate between the normal and the true cleistogamous flowers.

SOCIETIES AND ACADEMIES

LONDON.

Royal Society, December 5, 1895.—"The Measurement of High Potential Difference." By H. C. Leake, R. Leventhorpe, and C. S. Whitehead.

This paper describes firstly the method adopted by Prof. Ayrton and Mr. Mather for the accurate calibration of electrostatic voltmeters in electro-magnetic units. For this purpose a high alternating potential difference is employed, which can be measured by the apparatus in several ways, each of which is a check on the others. By means of a divided resistance and a new type of low-reading idiostatic electrometer, the high alternating potential difference can be measured without involving determinations of either current or resistance. It is probable that the measurements of 2000 volts are correct to about $\frac{1}{10}$ per cent. in terms of the Clark cell.

With the aid of this apparatus, and the most probable value of "v," the authors determined the accuracy with which measurements of steady potential differences of about 2000 volts could be made in terms of the absolute electrostatic unit by means of the Kelvin absolute electrometer, when used in the ordinary way, and they found that measurements made with this instrument were always too large by, on the average, $1\frac{1}{3}$ per cent.

They traced this error to imperfection in the action of the coach-springs, the greater part of which could be eliminated by keeping the springs constantly loaded.

The remaining error, which was due to change of temperature of the coach-springs, was reduced by very carefully shielding the instrument from heat when in use, and was finally eliminated by the use of a simple correction formula. This method of correction had the great advantage of not depending on thermometer readings, as the coach-springs themselves were virtually used as a metallic thermometer to indicate their own temperature.

With these precautions it was found possible on some occasions to make measurements with the absolute electrometer accurate in absolute electrostatic units to about $\frac{1}{10}$ per cent., in so far as the authors were able to judge; but it was found that on many days there was an error of about $\frac{1}{2}$ per cent. in the constant of the instrument, due to some inherent defect, intermittent in its action, which could not be satisfactorily explained.

A theoretical investigation is given to determine the most suitable values of the mass to be used for the initial adjustment of the coach-springs, and of the potential difference to which the electrometer should be charged, for the heterostatic measurement of a given potential difference, with the result that the former should be proportional to the $\frac{2}{3}$ power, and the latter to the first power of the potential difference to be measured. It is also shown that, in addition to the well-known advantages of the heterostatic over the idiostatic method, there is the additional advantage that the error in the ordinary assumption as to the value of the effective area of the attracted disk is of far less importance in the former than in the latter method.

Finally an investigation is given in which Schwarz's method is applied to determine the error in the ordinary assumption as to the value of the effective area, for the case when the disk and guard-ring are not quite in the same plane.

Geological Society, January 8.—Dr. Henry Woodward, F.R.S., President, in the chair.—A delimitation of the Cenomanian, being a comparison of the corresponding beds in Southern England and Western France, by A. J. Jukes-Browne and William Hill. The object of the authors has been to compare the beds which form the lower part of the Upper Cre-

taceous series in those parts of Southern England and Western France which are nearest to one another. They claim to have defined the limits of the Cenomanian stage in Western France, and to have shown that this group of beds is simply a southern extension of our Lower Chalk, formed in a shallower part of the Cretaceous Sea and nearer to a coast-line.—The Llandovery and associated rocks of Conway, by G. L. Elles and E. M. R. Wood, Newnham College. In the paper a full description of the representatives of the Birkhill, Gala (Tarannon), and Wenlock beds was given, and the distribution of the fossils (chiefly graptolites) in the various subdivisions was recorded. Many of the graptolites are forms which had been described from Swedish deposits, but had hitherto been unrecorded in this country.—The gypsum deposits of Nottinghamshire and Derbyshire, by A. T. Metcalfe. The gypsum deposits of these counties occur in the Upper Marls of the Keuper division of the Triassic system. The author described their occurrence in thick nodular irregular beds, large spheroidal masses, and lenticular intercalations, and their association with satin-spar, alabaster, selenite, and anhydrite.

EDINBURGH.

Royal Society, January 6.—The Hon. Lord M'Laren in the chair.—Dr. Buchan submitted a paper on the high temperatures of September, and the Ben Nevis observatories. He described briefly the weather of September generally, which was markedly anticyclonic, and selected for consideration the 28th, 29th, and 30th of the month, as being characteristic in an intensified degree. On these days, the state of the atmosphere at Fort William, and low levels in Scotland generally, was one of great humidity. On the top of the mountain, on the other hand, there was great dryness. It was the opinion of Prof. Tait, and other physicists whom he had asked, that when the vapour in the atmosphere existed as pure vapour, it was practically diatherminous to the sun's rays. Between the (reduced) barometer at the top of the mountain, and the barometer at Fort William with a temperature difference of four degrees, there was only a difference of half a tenth, while the calculated difference for such a difference in temperature should have been a hundredth. He considered this inquiry to be of value in the prediction of storms.—Dr. Knott read a paper on the strain produced in iron and nickel tubes in the magnetic field. He described the apparatus used, and the numerous difficulties to be overcome, and exhibited graphs of the volume-changes of the tubes. He had found the behaviour of steel tubes so extraordinary that he reserved it for further treatment.—Prof. Tait described some further work he had done in the study of the path of a rotating spherical projectile. From the equations involved he had deduced the paths which such a moving body should follow, and, though some of these looked extraordinary, being concave *upwards*, and even looped, he was not without hopes of reaching them in practice. He had already succeeded in the case of some of them, with a teetotum.

DUBLIN.

Royal Dublin Society, December 18, 1895.—Prof. A. C. Haddon in the chair.—Mr. A. Francis Dixon read a paper on the development of the branches of the fifth cranial nerve in man. The paper was illustrated by models of the fifth cranial nerve in five different stages of the human embryo.—Prof. Grenville A. J. Cole read a paper on the rhyolites of County Antrim, with a note on bauxite. These rocks, often spoken of as "trachytes," occur as isolated exposures among basalts. At Templepatrick, rhyolite is seen to be intrusive in the Lower Basalts; but elsewhere the junctions are quite obscure. The author believes that there is not justification for the construction of sections showing the supposed relations of the rocks; but he urges that the mass at Tardree Mountain is very complex, and he calls special attention to the extensive flows of fluidal, perlitic, and spherulitic lavas at Sandy Braes. The various rocks are described in detail, and a survey of this area suggests that the pale bauxites of Co. Antrim have been derived from the decomposition of the rhyolites. Soluble salts of aluminium may have been formed throughout the lavas by the action of solfataras, &c.; waters containing alkali-carbonates may have acted on these, causing the precipitation of the basic aluminium carbonate studied by MM. Urbain and Renoul; and the extreme instability of this compound may have given rise to aluminium hydrate, which would be washed down into lakes during the interval between the outpouring of the Lower and Upper Basalts, together with the iron oxide also found in bauxite. At Ballycloughan, north of Ballymena, a distinctly biotitic rhyolite occurs as an intrusive neck; and at Cloughwater there is a patch of most delicately fluidal character; both these have vertical flow-planes. The rhyolites of Co. Antrim are often poor in ferro-magnesian minerals, but soda-pyroxene is common at Carnearny and on Sandy Braes.—Prof. James Lyon described a system of hot-water supply for domestic purposes. In the case of hot-water supply by means of domestic boiler and circulating cylinder, in order to obviate the necessity for drawing off a quantity of cold water from the rising pipe before the hot water can be obtained, the rising pipe is often returned near the bottom of cylinder to produce circulation. When this is done a flap valve of special construction should be placed at the latter point, to prevent cold water supply from flowing from bottom of cylinder, and thus mingling with the hot water which is being drawn.

PARIS.

Academy of Sciences, January 27.—M. Cornu in the chair.—On the equilibrium of an elastic body, by M. H. Poincaré.—Of the utility of photography by the X-rays in human pathology, by MM. Lannelongue, Barthélemy, and Oudin. In diseases in which there is an actual loss of substance of the bone, or an abnormal growth of bony tissue, the photographs taken by the Röntgen method confirm the previous diagnosis.—On a non-linear differential equation of the second order with doubly periodic coefficients, by M. Hugo-Gyldén. A particular solution of an equation of importance in astronomy. Application is made of the solution to the planet Hilda (153) with a satisfactory result.—Biological studies on some Hirudinia, by M. A. Kowalevsky.—On the linear equations and the method of Laplace, by M. E. Goursat.—On the addition of the arguments in the periodic functions of the second order, by M. G. Fontené.—On the complete solutions of the equation

$$x_1 \tan^{-1}\frac{1}{\kappa} + x_2 \tan^{-1}\frac{1}{\kappa_2} + \ldots + x_n \tan^{-1}\frac{1}{\kappa_n} = k \cdot \frac{\pi}{4},$$

by M. Carl Stormer.—On certain invariants relating to a group of Hesse, by M. Boulanger.—On groups of operations, by M. Levasseur.—Theory of pitching on a rolling sea, by M. A. Kriloff.—Some properties of the Röntgen rays, by M. Jean Perrin. The conclusion is drawn that these rays are not identical with the kathodic rays, since the latter cannot pass out through vacuum tube walls of 1 mm. in thickness. The propagation of the Röntgen rays is shown experimentally to be linear; they are not reflected either by a mirror of polished steel or of glass, neither are they refracted by prisms of paraffin or wax. Unsuccessful attempts to form diffraction fringes showed that if the phenomenon is periodic, the period is much below that of green light.—Observations on the preceding communication by M. Poincaré, pointing out that Prof. Röntgen has already shown that the X-rays are not refracted.—Dark light, by M. Gustave Le Bon. An ordinary photographic dry plate, placed under a negative in a printing-frame, and the negative closely covered with a thin plate of iron, was exposed to the light of a paraffin lamp for three hours. Vigorous and prolonged development brought out a faint but well-defined image. If a plate of lead was wrapped round the back of the frame, and bent over the edges of the iron plate so as to enclose the printing-frame in a metallic box, after three hours' exposure to the same source of light an image was obtained "which was nearly as vigorous as if no obstacle had been interposed between the light and the plate." M. Le Bon proposes to continue the study of the properties of light after its passage through opaque bodies.—Action of heat on mercurous iodide, by M. Maurice François. To avoid the complications introduced by the presence of air, the mercurous iodide was heated *in vacuo*. The reaction is a limited one, equilibrium resulting when a fixed amount (depending on the temperature) of mercurous iodide has been broken up into mercury and mercuric iodide. Hence the reaction is reversible, and the same state of equilibrium results if mercury and mercuric iodide are taken and heated together.—The absorption of light by solutions of indophenols, by MM. Bayrac and Ch. Camichel. A quantitative study of the absorption spectra of homologous indophenols in various solvents. Relations are indicated between the positions of the absorption bands, concentrations, and molecular weights. One compound, obtained by the general method of preparation of indophenols from mono-methyl-resorcinol and *p*-nitroso-dimethyl-aniline hydrochloride, gives quite anomalous results, and hence the conclusion is drawn that this body is not an indophenol.—Combinations of aluminium chloride with phenols and

their derivatives, by M. G. Perrier.—On Russian essence of aniseed, by MM. G. Bouchardat and Tardy.—On the production of pure gaseous formic aldehyde, by M. A. Brochet. For the purposes of disinfection by gaseous formic aldehyde, free from water vapour, a current of a warm indifferent gas (nitrogen or carbon dioxide) is passed through a tube containing fragments of trioxymethylene. The quantity can be regulated by altering the temperature.—On antivenomous serum, by MM. Calmette, Hankin, and Lépinay. An account of some experiments with a serum, the injection of which protects the animal from snake venom.—On some points in the anatomy of *Tetraclita porosa*, by M. A. Gruvel.—New form of negative reaction on the retina, by M. Aug. Charpentier.—Proofs of the submarine extension to the south of Marseilles of the Maures and Esterel group, by MM. Vasseur and Fournier.

BERLIN.

Physical Society, December 13, 1895.—Prof. Warburg, President, in the chair.—The President referred to the deaths of Prof. Knoblauch, of Halle, and Prof. Spörer, of Potsdam.—Prof. Des Coudres spoke on kathodic radiation, and demonstrated its sensitiveness to magnetic lines of force.—Prof. Neesen described two interesting strokes of lightning, of which one pierced the roof of a church-tower unprovided with a conductor, and stopped short at the organ. Its effects were characterised by the rents it made in the inside of the church above the organ, similar to those observed in a tree when struck. The second struck a petroleum store, whose four tanks were each protected by five-pointed conductors adequately put to earth. Two of the tanks were completely shattered by a violent explosion, the other two burnt out by fire. The speaker was of opinion that the petroleum vapours above the tanks had been ignited by small sparks during the discharge, and he had verified this view by experiment; he therefore proposed that for the purpose of adequate protection all openings, more particularly manholes, should be guarded by wire netting, on the principle of the Davy lamp.—A small instrument was exhibited by Mr. von Hefner-Alteneck for demonstrating minute variations of atmospheric pressure. It consists of a flask, whose neck communicates with a horizontal glass tube, whose central portion is bent slightly downwards; in this tube there is an extremely mobile index of coloured petroleum, which follows the least change of external pressure. The apparatus is one hundred and fifty times more sensitive than a mercurial barometer.—Prof. Neesen criticised a recently published method of measuring the velocity of projectiles. It consists in making the projectile close and open a current which passes spirally round a tube containing carbon bisulphide; the plane of polarisation of this fluid is rotated during the time of flight, and hence a beam of light previously extinguished by crossed Nicols can now pass through, and make a record on photographic paper.

Physiological Society, December 6, 1895.—Prof. H. Munk, President, in the chair.—Prof. I. Munk reported on further experiments as to the minimal proteid requirements of a dog during nitrogenous equilibrium.

December 20.—Prof. H. Munk, President, in the chair.—Dr. Cohnstein reviewed the laws of osmotic pressure from the existing point of view of physical chemistry.—Dr. Rosenberg spoke on reported cases of presumed regeneration of the bile duct some twenty days after its extirpation. He reported a case of a lateral branch from the duct recently observed in a dog and leading into the intestine, and urged that the possible existence of such a branch should have been in every case disproved before concluding that a regeneration of the duct had taken place.—The President exhibited a section of an elephant's tooth, which showed a circular green streak round the outer border of the pulp cavity.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Eclipses du Soleil et Occultations: L. Cruls (Rio de Janeiro).—Le Climat de Rio de Janeiro: Ditto (Ditto).—Posicões Geographicas: Ditto (Ditto).—Iowa Geological Survey, Vol. 4 (Des Moines).—Ex-Meridian Altitude Tables: Brent, Walter, and Williams (Philip).—A Naturalist in Mid-Africa: J. F. Scott Elliot (Innes).—Domesticated Animals: N. S. Shaler (Smith, Elder).—Practical Studies in Fermentation: Dr. E. C. Hansen, translated by Dr. A. K. Miller (Spon).—Petroleum: B. Redwood, 2 vols. (Griffin).—Computation Rules and Logarithms: Prof. S. W. Holman (Macmillan).—Catalogue of the Mesozoic Plants in the Department of Geology, British Museum (Natural History): The Wealden Flora: A. C. Seward, Part 2 (London).—Catalogue of the Fossil Fishes in the British Museum (Natural History): A. S. Woodward, Part 3 (London).—Roads and Pavements in France: A. P. Rockwell (Chapman).—Cyanide Processes: E. B. Wilson (Chapman).—Heating and Ventilating Buildings: Prof. R. C. Carpenter (Chapman).—Manual of Lithology: Prof. E. H. Williams, jun. (Chapman).—Vegetable Culture: A. Dean (Macmillan).—Lessons in Elementary Botany: T. H. MacBride (Boston, Mass., Allyn).—University Correspondence College Calendar, 1895-96 (Red Lion Square).—Catalogue of Scientific Papers (1874-1883), compiled by the Royal Society of London, Vol. xi. (C. J. Clay).

PAMPHLETS.—The Authentic Letters of Columbus: W. E. Curtis (Chicago).—Contribution to the Flora of Yucatan: C. F. Millspaugh (Chicago).—Variation of Latitude at New York City. Part 1: Declinations and Proper Motions of Fifty-six Stars: Dr. H. S. Davis (New York).—Shanghai Meteorological Society. Third Annual Report: Essay on the Winter Storms of the Coast of China: Rev. S. Chevalier (Shanghai).—Laboratory Tables for Qualitative Analysis (Manchester, Cornish).—Handbook and Catalogue of the Meteorite Collection: Dr. O. C. Farrington (Chicago).—The Honey-Bee: F. Benton (Washington).—Proceedings of the Seventh Annual Meeting of the Association of Economic Entomologists (Washington).

SERIALS.—Proceedings of the Academy of Natural Sciences of Philadelphia, 1895, Part 2 (Philadelphia).—Proceedings of the Rochester Academy of Science, Vol. 2, Parts 2 and 4 (Rochester, N.Y.).—Proceedings and Transactions of the Nova Scotian Institute of Science, Session 1893-94 (Halifax, Nova Scotia).—Zeitschrift für Physikalische Chemie. xix. Band, 1 Heft (Leipzig, Engelmann).—History of Mankind: F. Ratzel, translated (Macmillan).—Cassell's History of England, Part 1 (Cassell).—Humanitarian, February (Hutchinson).—Royal Gardens, Kew. Bulletin of Miscellaneous Information, 1895 (Eyre).—Proceedings of the Physical Society of London, Vol. 13, Part 13; Vol. 14, Part 1 (Taylor).—Contemporary Review, February (Isbister).—Terrestrial Magnetism, No. 1 (Chicago).—National Review, February (Arnold).—Fortnightly Review, February (Chapman).—American Journal of Mathematics, January (Baltimore).—Centralblatt für Anthropologie, &c., 1 Jahrg., Heft 1 (Williams).—Journal of the Chemical Society. December (Gurney).—Century Magazine, February (Macmillan).—Geographical Journal, February (Stanford).—Science Progress. February (Scientific Press).

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